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ONTARIO GEOLOGICAL SURVEY

Open File Report 6024

Geology of the Monteith Area

by

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2000

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Parts of this report may be quoted if credit is given. It is recommended that reference be made in the following form:

Berger, B.R. 2000. Geology of the Monteith area; Ontario Geological Survey, Open File Report 6024, 77p.

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Abstract

Neoarchean metavolcanic and metasedimentary rocks were subdivided into 4 lithotectonic assemblages. The Kidd–Munro assemblage is predominantly tholeiitic flows with subordinate komatiitic, intermediate and felsic flows. Trace element geochemistry indicates that N-MORB and transitional MORB basalts are present. Felsic metavolcanic rocks with F-III, F-II and F-I trace element characteristics are associated with the transitional MORB basalts in the southern part of the assemblage. Tonalite displays F-III trace element patterns and is interpreted to be the intrusive equivalent of the felsic metavolcanic rocks in Wilkie Township. Part of the tholeiitic Dundonald Sill is intrusive into the Kidd–Munro assemblage in northwestern Clergue Township.

The Bowman assemblage underlies the southern part of the Monteith area and is composed of tholeiitic, N-MORB basalts with minor komatiitic flows and felsic intrusive rocks.

The Duff–Coulson–Rand assemblage in the northern part of the map area is calc-alkalic intermediate and felsic epiclastic, pyroclastic and flows with F-I trace element geochemistry. Wacke, argillite and island-arc-like basalts are intercalated with the felsic rocks and indicate a distal depositional environment.

Hoyle assemblage turbidites are fine-grained, thinly bedded rocks that indicate regional derivation from westerly sources. The wacke and argillite were intruded by calc-alkalic quartz-feldspar porphyry with F-I trace element geochemistry.

The Porcupine–Destor, Pipestone and a previously unmapped regional fault mark contacts between the assemblages. Reverse south-side-up movement occurred on the Porcupine–Destor fault, however, the sense of movement is unknown on the other two faults. These regional faults are cut by younger northwest- to northeast-striking brittle faults that commonly display east-side-down vertical movement.

Several gold deposits and occurrences are associated with the Porcupine–Destor and Pipestone faults. There is untested gold potential with the fault separating the Kidd–Munro from the Duff–Coulson–Rand assemblages. Base metal mineralisation is associated with the F-III rhyolites in the Kidd–Munro assemblage and there remain several untested airborne electromagnetic conductors in the map area. Komatiite-hosted copper-nickel mineralisation occurs immediately west of Clergue Township and there is untested potential in the map area. Gold-copper-molybdenum mineralisation occurs in quartz-feldspar porphyry in Carr Township indicating that there is potential for large-tonnage, low-grade deposits in this area.

Introduction

The Monteith area is bounded by UTM grid zone 17 coordinates 514000 and 543000 easting and 5376000 and 5395000 northing and includes Clergue, Walker, Wilkie, Taylor and Carr townships. Geological mapping and compilation were carried out at 1:50 000 scale to encourage mineral exploration and to improve the geological database. The centre of the area is approximately 60 km east of Timmins and includes the communities of Matheson, Monteith and Val Gagne. Highways 11 and 101 are major transportation routes and secondary highways 67, 577 and 626 provide access to most of the western part of the map area. Numerous concession and secondary logging roads provide access to all but the northern parts of Walker and Wilkie townships. The Abitibi and Black rivers are major waterways within the map area and the Driftwood and Shallow rivers also provide water access.

History of Exploration

In 1912, Alexo Mines Limited exploited nickel and copper from a small deposit in Dundonald Township and explored by diamond drill mining claims in lot 12, Concession III in Clergue Township. Further exploration was carried out in Clergue Township by Dominion Gulf Company in 1954, by Canadian Nickel Company Limited in 1972 and by Falconbridge Nickel Mines Limited in 1972. An isolated occurrence of copper-zinc-nickel mineralisation was encountered in lot 10, Concession III by Canadian Nickel Company Limited, however no follow-up work was reported.

In 1938, a landslide on the Driftwood River exposed auriferous quartz veins in a felsic porphyry in lot 1, Concession I in Clergue Township and subsequent exploration by Montclerg Mines Limited resulted in discovery of a small gold deposit. This deposit was explored in 1986 by Consolidated Montclerg Mines Limited at which time approximately 371 000 tons at 0.132 ounce gold per ton were defined. The deposit is spatially associated with a northeast-striking splay of the Pipestone fault.

Wilcarr Mines Limited also explored along the Pipestone fault in northeastern Carr Township and southern Wilkie Township in 1944. Diamond drilling of geophysical targets resulted in discovery of erratic gold mineralisation associated with quartz veining and carbonate-sericite alteration. Maude Lake Gold Mines Limited tried to duplicate Wilcarr's results without success in 1986.

Hollinger Consolidated Gold Mines Limited started an ambitious program of diamond drill testing the entire inferred lengths of the Porcupine–Destor deformation zone and the Pipestone fault in the 1930s. Hollinger and its various successor companies through to 1989 continued this work on selected parcels of land. The systematic exploration program resulted in discovery of gold deposits at the Shoot Zone, Porphyry Zone and West Porphyry Zone in Taylor Township. Gold mineralisation was also discovered on the Jeffris patent in Carr Township and all gold occurrences are associated with the Porcupine–Destor deformation zone. St Andrew Goldfields Limited now owns the gold deposits and exploration work is ongoing. Gold reserves are reported to be 1 150 000 tons at 0.157 ounces of gold per ton to the 300 m level at the Shoot Zone, 1 300 000 tons at 9.6 grams gold per ton at the West Porphyry Zone and 265 645 tons at 0.071 ounce gold per ton at the Porphyry Zone (Northern Miner, February 3, 1997; Canadian Mines Handbook, 1995; St Andrew Goldfields Limited, press release, November 21, 1996).

Gold exploration along the major fault zones continues and some of the more recent results include reported assays of 4.66 ounces gold per ton over 0.6 m in diamond drill core from lot 4, Concession II, Carr Township by C.E. Parsons (1993); 0.17 ounce gold per ton over 0.3 m from lots 2 to 5, Concession II, Wilkie Township by E. Fournier (1993); 0.357 ounce gold per ton over 0.25 m from lots 4 and 5, Concession III, Taylor Township by Goldex Resources Incorporated in 1986 and 0.119 ounce gold per ton over 1.5 m from lot 11, Concession II, Taylor Township by Quebec Sturgeon River Mines Limited in 1983.

Noranda Exploration Company Limited was first to report base metal mineralisation from lot 10, Concession II, Wilkie Township in 1962 where 1.42% Cu over 4.1 m hosted in mafic metavolcanic rocks was encountered in diamond drill core. Further work did not expand the mineralised zone.

Monpre Mining Company Limited explored lot 1, Concession I and II in Walker Township and reported 0.3% Cu and 0.5% Zn over 0.1 m from diamond drill core in felsic metavolcanic rocks in 1964.

Kidd Creek Mines Limited and its successor company Falconbridge Limited explored a large package of ground in Wilkie and Walker townships covering the Noranda and Monpre occurrences in the 1980s and 1990s. Several diamond drill holes encountered stringer chalcopyrite, sphalerite and galena within a package of hydrothermally altered rocks however no continuous mineralisation or tonnage has been reported.

Base metal exploration has also been carried out in northern Walker and Wilkie townships with assays up to 4400 ppm Cu and 5300 ppm Zn reported from graphitic metasedimentary rocks and intercalated felsic tuff.

Canamax Resources Incorporated explored lot 7, Concession V in Carr Township and reported the discovery of disseminated copper, gold and molybdenum in quartz-feldspar porphyry in 1983. Falconbridge Limited and Pentland Firth Ventures Limited have carried out more recent exploration in the area and assays up to 0.35 % Cu over 30 m and 1030 grams gold per ton over 0.3 m are reported.

A number of mining claims were in good standing as of December, 1996 and exploration activity was on-going at the Shoot Zone and West Porphyry Zone gold deposits.

Previous Geological Work

Preliminary maps at 1:15 840 scale cover each of five townships in the map area (Ginn and Leahy 1960; Leahy and Ginn 1961; Ginn and Carlson 1965; Prest 1951a, 1951b; Satterly 1959). Large-scale compilation maps by Ginn et al. (1964) and Pyke et al. (1973) cover the map area. A ground vertical field magnetic survey was carried out over Clergue Township by the Ontario Geological Survey (McCance 1974). Airborne magnetic and electromagnetic surveys cover the entire map area (OGS 1984a-e). Data series maps P.857 and P.2335 cover Walker and Clergue townships; Geological Data Inventory Folios (GDIF) 264, 265, 368, 400 and 401 cover the map area. Recent preliminary OGS maps cover Dundonald and Stock townships which are west and southwest of the map area (Muir 1995a, 1995c) and previous mapping by Johnstone (1991a) and Leahy (1964) covers the area east and south of the map area.

Present Survey

The Monteith area was mapped at 1:50 000 scale during the 1996 field season. The mapping crew consisted of the author and one assistant. A combination of outcrop mapping, examination of diamond drill core, compilation of geological and geophysical data and use of computer-enhanced images of geophysical data were used to complete the geological maps. Private company geological maps were compiled where appropriate and available.

Diamond and sonic drill core stored at the Ministry of Northern Development and Mines' drill core libraries in Timmins and Kirkland Lake were examined and in some places sampled. Exploration companies were approached and permission was sought to make drill core, bedrock chips, drill logs and other data available for integration onto the maps. The locations of drill hole collars provided on drill logs and sketches in assessment and private company files were transferred to the base maps. The locations of these holes are referenced to lot and concession boundaries or to recognisable geographic features in each township and as the locations of very few of the drill holes were actually checked in the field there may be some error in their location. Based on the prevailing vertically dipping style of the geology, diamond drill holes were projected vertically to surface based on the azimuth and declinations

recorded on the drill logs. Most drill data was, on average, examined only once by exploration companies with the greatest emphasis most commonly placed on economic mineralisation. The present survey examined the data with respect to regional geological units with emphasis on the position and nature of contacts between major rock types. The geology of approximately 114 diamond drill holes is included on Map P.3367 (back pocket) and details of location are included in Appendix 1. Drill core examined by the author show no prefixes before the codes on the map. Geological codes were taken from the drill logs but where the author examined no core lithologic codes are prefixed by the letter D on Map P.3367.

The Ontario Geological Survey carried out an extensive sonic drill program in the map area as part of Black River–Matheson program (BRIM) in the 1980s. These holes are essentially vertical and designed to examine and prospect the Quaternary stratigraphy for glacially entrained minerals of economic importance, most commonly gold and base metals. It is common practise when boring these holes to penetrate at least 1.5 m into the bedrock. Bedrock core were examined, sampled, described on the drill logs and stored for future use at the Timmins and Kirkland Lake drill core libraries. The author examined several core samples and included the results from 40 sonic drill holes on Map P.3367. Location of the holes is detailed in Appendix 1.

There are numerous geophysical and geological reports and maps available to the public at the Resident Geologists' Offices, Ministry of Northern Development and Mines, Timmins and Kirkland Lake. All of these files were examined and pertinent data were incorporated onto the map.

Airborne total intensity magnetic and electromagnetic surveys carried out for the Ontario Geological Survey in 1984 were used extensively to delineate geological contacts and to infer the presence of fault and fold structures (OGS 1984a-e). Coloured versions of the total intensity magnetic data were produced to enhance subtle geological and structural features in the area. Coloured images of the calculated second vertical derivative and directionally filtered second vertical derivative magnetic data were consulted and formed a valuable adjunct to interpretation of the geological features in the map area. These data were manipulated with respect to inclination and declination of the "sun" angle to enhance subtle features and to provide maximum use of the data.

Once collected, all the data were compiled and synthesised. Inevitably, the various bits of information presented some conflicts and contradictions. In order to resolve these problems the data was interpreted as a "best fit" from all sources. This type of holistic approach was the major guide in preparation of the maps and this report.

Acknowledgements

The help of the staff of the Resident Geologist offices in Timmins and Kirkland Lake is gratefully acknowledged. P. St. Pierre capably assisted the author in the field. Falconbridge Limited permitted examination and sampling of diamond drill core and provided financial assistance for some of the geochemical analyses included in this report; their help is gratefully acknowledged.

General Geology

Neoarchean supracrustal rocks of the Abitibi Subprovince of the Canadian Shield underlie the Monteith area. Ultramafic, mafic, intermediate and felsic metavolcanic rocks, and clastic metasedimentary rocks were intruded by ultramafic, mafic and felsic plutonic rocks and by Paleoproterozoic and Keweenawan diabase dikes (Table 1).

The supracrustal rocks were subdivided into rock packages based on composition, morphology and geographic distribution. Jackson and Fyon (1991) termed the subdivisions lithostratigraphic assemblages. An "assemblage" is defined as consisting of stratified volcanic and/or sedimentary rock units built during a discrete interval of time in a common depositional or volcanic setting. An assemblage is typically bounded by faults, unconformities or intrusions (Thurston 1991).

Table 1. Lithologic units for the Monteith area.

PHANEROZOIC

CENOZOIC

QUATERNARY

HOLOCENE

Lake, stream, wetland deposits

PLEISTOCENE

Glaciofluvial and glaciolacustrine sand and gravel deposits, glaciolacustrine clay, boulder and gravel till

UNCONFORMITY

PRECAMBRIAN

PROTEROZOIC

KEWEENAWAN

MAFIC INTRUSIONS

Olivine diabase dikes

PALEOPROTEROZOIC

MAFIC INTRUSIONS

Diabase dikes

INTRUSIVE CONTACT

ARCHEAN

NEOARCHEAN

METAMORPHOSED FELSIC AND INTERMEDIATE INTRUSIVE ROCKS

Quartz ± feldspar porphyry, feldspar porphyry, tonalite and tonalite/trondjhemite dikes, schist

METAMORPHOSED ULTRAMAFIC AND MAFIC INTRUSIVE ROCKS

Peridotite, pyroxenite, schist, gabbro, anorthositic gabbro and pegmatitic veins

CLASTIC AND CHEMICAL METASEDIMENTARY ROCKS

Wacke, siltstone, mudstone, graphitic and pyritic mudstone, schist, chert and conglomerate

FELSIC METAVOLCANIC ROCKS

Flows, autoclastic flow breccia, tuff, breccia, lapilli tuff, schist, graphite breccia, spherulitic and quartz-feldspar-phenocrystic varieties

INTERMEDIATE METAVOLCANIC ROCKS

Massive, flow-laminated and pillowed flows, flow-top and pillow breccia, tuff, lapilli tuff and tuff breccia, schist, graphite breccia, amygdaloidal, plagioclase-phenocrystic and variolitic varieties

MAFIC METAVOLCANIC ROCKS

Massive and pillowed flows, pillow and flow-top breccia, tuff and lapilli tuff, schist, variolitic and amygdaloidal units, plagioclase-bearing units, leucoxene-bearing units, and graphite breccia

ULTRAMAFIC AND MAFIC METAVOLCANIC ROCKS (KOMATIITES)

Massive, spinifex- and polysuture-textured flows, schist, basaltic komatiite, and graphite breccia

Neoarchean rocks in the map area are subdivided into four assemblages. The Duff–Coulson–Rand assemblage is composed of subequal amounts of clastic metasedimentary and metavolcanic rocks and underlies the northern-most 15% of the map area. The Kidd–Munro assemblage is composed predominantly of mafic metavolcanic rocks with subordinate amounts of felsic, intermediate and ultramafic metavolcanic rocks and is separated from the Duff–Coulson–Rand by an easterly striking shear zone. The regional Pipestone fault separates the Kidd–Munro assemblage from the Hoyle assemblage that is composed of turbiditic clastic metasedimentary rocks that were intruded by calc-alkalic quartz-feldspar porphyritic stocks. The Porcupine–Destor deformation zone marks the contact between the Hoyle and Bowman assemblage that is composed of mafic metavolcanic rocks in the map area.

The Duff–Coulson–Rand assemblage is composed of easterly trending mafic, intermediate and felsic metavolcanic rocks intercalated with subequal volumes of clastic metasedimentary rocks. The intermediate metavolcanic rocks are distinctly pyroxene and/or plagioclase phyric that is inferred to reflect calc-alkalic geochemistry. Jackson and Fyon (1991) indicate that the assemblage is divisible into 3 principal units: the Rand unit composed of calc-alkalic metavolcanic rocks, the Coulson unit composed of clastic metasedimentary rocks and the Duff unit composed of felsic metavolcanic rocks. All 3 units are present in the map area. In addition, tholeiitic mafic metavolcanic rocks comprise a significant proportion of the assemblage and these rocks extend west into Dundonald Township where magnetic gabbro and ultramafic intrusive rocks occur (Muir 1993). Corfu (1993) indicated a U-Pb zircon age date of approximately 2713 Ma for felsic metavolcanic rocks correlated with the Duff–Coulson–Rand assemblage east of the map area.

Airborne magnetic data (OGS 1984a-c) indicate that the Duff–Coulson–Rand assemblage is composed of generally low susceptibility magnetic units. There are relatively few high intensity magnetic units in the assemblage and those that are present are correlated with narrow ultramafic and mafic metavolcanic flows. Electromagnetic conductors define easterly striking linear "trains" which are correlated with graphitic and pyritic interflow metasedimentary units in areas of relatively low magnetism.

The Kidd–Munro assemblage is composed predominantly of mafic metavolcanic rocks with lesser amounts of ultramafic and felsic metavolcanic rocks in the map area. Intermediate metavolcanic flows are localised in Clergue Township where they are spatially associated with komatiitic metavolcanic rocks and tholeiitic ultramafic and mafic intrusive rocks correlated with the Dundonald Sill (Green and MacEachern 1990). Metasedimentary rocks are rare and generally confined to narrow interflow units. Reversals in younging directions determined by flow features indicate folding about easterly to northeasterly trending axes. Jackson and Fyon (1991) reported that felsic metavolcanic rocks in Beatty Township, east of the map area, are 2714 Ma and are similar in age to felsic metavolcanic rocks at the Kidd Creek mine (Bleeker et al. 1996).

The Kidd–Munro assemblage is geophysically characterised by easterly trending airborne magnetic and electromagnetic trends which are interrupted locally by northeast- and north-trending diabase dikes and faults (OGS 1984a-e). The Dundonald Sill is characterised by a prominent magnetic high that defines part of a northeast-closing fold in Clergue Township and is abruptly terminated at a north-trending fault. Komatiitic volcanic rocks define discontinuous linear magnetically high units within the assemblage and display a close spatial association with airborne electromagnetic anomalies; however, the abundance of ultramafic metavolcanic rocks and electromagnetic conductors is much less than in the Kidd–Munro assemblage west and east of the map area (Berger 2000; Johnstone 1991). The paucity of ultramafic rocks is attributed by the author to a depositional environment distal from the sources of ultramafic volcanism.

The Hoyle assemblage forms a 6 km wide easterly trending band of predominantly fine-grained, turbiditic clastic metasedimentary rocks in the south-central part of the map area. Calc-alkalic quartz- and feldspar-porphyritic stocks intruded the metasedimentary rocks and host disseminated copper and auriferous quartz veins in one location. A U-Pb zircon depositional age based upon detrital zircons of 2699 Ma is reported for the structural footwall metasedimentary rocks correlated with the Hoyle assemblage at the Kidd Creek Mine and this date appears to be applicable to all wacke sequences in the Timmins area (Bleeker et al. 1996).

Low intensity magnetism characterises the metasedimentary rocks of the Hoyle assemblage (OGS 1984d, 1984e). The porphyry intrusions, however, display higher magnetic susceptibility and stand out on total field and second

vertical derivative maps (OGS 1984d, 1984e). Prominent linear magnetic highs in the area of this assemblage correspond to Paleoproterozoic and Keweenawan diabase dikes. The Hoyle assemblage is characterised by weak electromagnetic conductivity.

The Bowman assemblage underlies the southern-most part of the area and is composed predominantly of mafic metavolcanic rocks. Ultramafic metavolcanic rocks restricted to the Porcupine–Destor deformation zone are tectonically interleaved with metasedimentary rocks of the Hoyle assemblage and are intruded by trondjhemite/tonalite dikes and sills. Jackson and Fyon (1991) inferred that the Bowman assemblage was approximately 2705 Ma. Worden et al. (1995) concluded that trondjhemite dikes in Taylor Township were approximately 2682 Ma and were syntectonic.

The ultramafic rocks display high magnetic susceptibility in the Porcupine–Destor deformation zone and are the most prominent geophysical feature of the Bowman assemblage in the map area. Mafic metavolcanic rocks display low magnetic susceptibility and their distribution is masked by the prevalent diabase dike swarms.

NEOARCHEAN

Ultramafic Metavolcanic Rocks

Ultramafic metavolcanic rocks occur as massive, spinifex- and polysutured-textured flows, basaltic komatiitic flows and derived schist in the Kidd–Munro and Bowman assemblages. Ultramafic metavolcanic rocks are geophysically interpreted to occur locally within the Duff–Coulson–Rand assemblage; however, no samples of ultramafic rocks were observed in outcrop or drill core by the author and the high magnetic responses may be due to some other magnetic rock type.

Ultramafic metavolcanic rocks comprise approximately 5 to 10% of the Kidd–Munro assemblage and are composed of massive cumulate-textured flows and schist with lesser amounts of spinifex-textured flows. Airborne magnetic highs inferred to mark the location of ultramafic flows are most common in the vicinity of the Pipestone fault and along the regional shear zone which defines the contact between the Duff–Coulson–Rand and Kidd–Munro assemblages. Komatiitic metavolcanic rocks were intruded by the ultramafic-mafic Dundonald Sill in western Clergue Township and distinction between members of these two rock suites is difficult based solely on magnetic signature. Individual ultramafic flows are generally less than 1 m thick and commonly occur as discontinuous lenses that form stacked flow unit sequences or they are interlayered with mafic metavolcanic flows and less commonly with wacke. Many electromagnetic conductors are spatially associated with ultramafic rocks and are caused by graphite and sulphide mineralisation where they have been diamond drill tested.

Massive cumulate ultramafic rocks composed of featureless black, dark green and green, fine- to medium-grained peridotite are common. In thin section these rocks are characterised by adcumulate, mesocumulate and orthocumulate textures with interstitial material composed of fine spinifex-textured pyroxene, massive amphibole, talc and serpentine. Pyroxene spinifex is well preserved in the thickest accumulation of ultramafic flows (up to 1 km), in east central Wilkie Township and was observed less commonly in diamond drill core elsewhere in the Kidd–Munro assemblage. Ultramafic schist is common throughout the Kidd–Munro assemblage and is composed of subequal amounts of talc, serpentine and chlorite. Carbonate is common only in schist within the Pipestone fault zone and is most common in the vicinity of the Montclerg gold deposit in Clergue Township.

Basaltic komatiitic rocks are dark green to pale green, non-magnetic and generally massive. These rocks are spatially associated with spinifex- and cumulate-textured ultramafic flows and less commonly associated with variolitic mafic metavolcanic rocks. In thin section these rocks are plagioclase and amphibole bearing which distinguishes them from their more ultramafic counterparts. It is probable that basaltic komatiite flows are more numerous than portrayed on Map P.3367 (back pocket) as these rocks are difficult to distinguish from magnesium tholeiitic basalts that occur in the map area. The association with spinifex- and cumulate-textured ultramafic flows is the most valid way to recognise these rocks in the absence of whole rock geochemistry.

Ultramafic rocks are much more abundant in the Kidd–Munro assemblage east and west of the Monteith area (Berger 2000; Johnstone 1991b; Jackson and Fyon 1991). Thick accumulations of komatiitic flows and ultramafic-mafic subvolcanic sills in the Kidd Creek Mine and Munro Township areas indicate that depositional environments in these areas were more proximal to magma sources than in the Monteith area. Restriction of the ultramafic flows to the vicinity of the regional structures suggests that these structures acted as magma conduits.

Ultramafic metavolcanic rocks in the Bowman assemblage are found only within the Porcupine–Destor deformation zone in the map area. They are composed mainly of talc-carbonate schist; massive and spinifex-textured flows are preserved locally. Ultramafic schist in western Taylor Township is tectonically interleaved with clastic metasedimentary rocks of the Hoyle assemblage and are intruded by quartz- and feldspar-porphyritic trondjhemite dikes and sills. The ultramafic schist near the Shoot Zone, Porphyry and West Porphyry gold deposits is hydrothermally altered and now contains quartz, sericite, green mica, albite and abundant carbonate in addition to talc and serpentine. The spatial restriction of the ultramafic rocks to the Porcupine–Destor deformation zone implies that it may have been a crustal-scale structure that acted as a conduit for komatiitic magma.

Mafic Metavolcanic Rocks

Mafic metavolcanic rocks comprise significant portions of the Kidd–Munro, Bowman and Duff–Coulson–Rand assemblages. The Kidd–Munro assemblage is composed of pillowed and massive flows with significant amounts of pillow breccia and flow-top breccia. Many of the massive flows are gabbroic textured and were previously interpreted as gabbro sills (Ginn and Leahy 1960; Leahy and Ginn 1961; Ginn and Carlson 1965). Tuff, variolitic and amygdaloidal rocks are minor. Leucoxene-bearing mafic metavolcanic rocks have been distinguished on Map P.3367 (unit 2k) because some industry geologists believe this mineral is spatially related to gold mineralisation. Graphite breccia (unit 2j, Map P.3367) is composed of angular mafic metavolcanic clasts in a graphite-, chlorite- and carbonate-bearing matrix and is more fully described below. Plagioclase-bearing mafic metavolcanic rocks form discrete units within the assemblage and are designated "2m" on Map P.3367.

Mafic metavolcanic rocks form most of the Bowman assemblage in the southern part of the map area. Pillowed and massive flows are most common; pillow breccia is rare; schist occurs in the Porcupine–Destor deformation zone. Amygdaloidal flows occur in several places in the assemblage.

DUFF–COULSON–RAND ASSEMBLAGE

Phaneritic mafic flows are exposed along the Abitibi River in northern Walker Township. These rocks are green, gabbroic-textured massive flows that display few primary or tectonic structures. Pillowed and massive mafic flows were encountered in diamond drill holes sunk in northern Clergue Township where they are in stratigraphic contact with wacke and graphitic argillite. Jensen and Baker (1986) reported that magnesian tholeiitic basalt was encountered in a sonic drill hole in northwestern Clergue Township. The mafic metavolcanic rocks appear to have been deposited in a subaqueous environment based on the limited amount of data. These mafic metavolcanic rocks are correlated with the Duff–Coulson–Rand assemblage based on their spatial association with clastic metasedimentary and intermediate metavolcanic rocks that are characteristic of the assemblage (Jackson and Fyon 1991; Berger 2000. The mafic rocks extend westward into Dundonald Township where Muir (1995a) inferred they were intercalated with mafic/ultramafic sills and intermediate metavolcanic rocks.

KIDD–MUNRO ASSEMBLAGE

Mafic metavolcanic rocks in the Kidd–Munro assemblage are composed predominantly of pillowed and massive flows which are well exposed in eastern Clergue and western Walker townships. Pillows are uniformly between 30 to 100 cm long and 15 to 70 cm across. They are well formed, close packed and have thin selvedges (0.5 to 1.5 cm).

Pillow shapes provide abundant indications of reversals of stratigraphic tops that were used to infer the location of fold axes. Amygdaloidal and variolitic mafic flows are common locally and in certain areas can be used to trace stratigraphy along strike. For instance, chlorite-filled amygdules (1 to 4 mm in size) are unique to a pillowed flow unit in lots 4, 5 and 6, Concession I, Clergue Township and mark the stratigraphic footwall to pyrite and graphite mineralisation. Variolitic pillowed flows in southern Walker Township can be traced into central Wilkie Township (9 km distance) and underlie a felsic metavolcanic unit which is a potential host for base metal mineralisation. Further, pillowed flows in central Walker Township display well-developed concentric cooling cracks and this flow unit can be traced 1.5 km along strike into Clergue Township. These examples demonstrate that consistent stratigraphy is well developed in this part of the Kidd–Munro assemblage.

Massive, phaneritic units are common throughout the Kidd–Munro assemblage and may, in part, represent subvolcanic sills (Ginn and Leahy 1960; Leahy and Ginn 1961; Ginn and Carlson 1965). These rocks are medium- to coarse-grained and are generally featureless. Rarely, chlorite-filled amygdules comprise less than 5% of the rock and narrow pillowed flows are locally interbedded with the massive flows. These flows generally contain microscopic quartz and in many places primary clinopyroxene is preserved.

Pillow and flow breccia are locally abundant within the Kidd–Munro assemblage and stacked units over 100 m thick were observed in lot 4, Concession III, Clergue Township. These rocks are characterised by monolithic fragments of mafic metavolcanic rocks from 1 cm to 50 cm in size that are poorly sorted, poorly bedded and generally ungraded. Thin continuous and discontinuous pillowed and massive flows are locally interbedded with the fragmental rocks. In many places hyaloclastite was observed to form thin discontinuous units overlying pillowed flows. Pillow and flow breccia appears to be more abundant in the central and northern parts of the Kidd–Munro assemblage but the folding which has affected the assemblage complicates this observation.

Pillowed and massive variolitic mafic metavolcanic rocks comprise a distinctive unit that forms the stratigraphic footwall to felsic metavolcanic rocks in southern Walker and Wilkie townships. White to chalky varioles (1 to 3 mm in size) which comprise 40 to 80% of the rock occur in a dark green aphanitic groundmass. In many places varioles were observed to have coalesced into felsic pods and along the Black River in lot 3, Concession II, Walker Township variolitic pillowed flows were observed to pass up-section into massive variolitic dacite. Whole rock and trace element geochemistry from samples of this dacite indicate that these rocks contain elevated Zr, Y and P_2O_5 and have REE patterns similar to F-II rhyolites (Lesher et al. 1986; *see* "Geochemistry"). The variolitic rocks are a unique marker unit in this part of the Kidd–Munro assemblage because of their distinctive morphology. The proximity of this unit to potential base-metal-bearing felsic metavolcanic rocks indicates that the recognition of variolitic rocks may be economically important. Gelinas et al. (1976) described similar variolite morphology from Quebec and concluded that this type of variolite was derived by immiscible separation of felsic and mafic liquids; a consequence of extreme fractionation.

Plagioclase-bearing mafic metavolcanic flows are localised in the central part of Clergue and Walker townships where pillowed and massive flows form a mappable unit (5000 m by 200 m). Similar pillowed mafic flows were observed in one outcrop in lot 3, Concession II, Wilkie Township suggesting that the plagioclase-bearing rocks can be extended through most of the Kidd–Munro assemblage in the map area. These rocks contain anhedral to euhedral plagioclase phenocrysts (up to 3 cm in size) in a fine-grained epidote-rich groundmass and resemble "leopard rock" described in other parts of the Superior Province, Canada (Berger 1989; Green 1975). Geochemistry indicates these rocks vary from magnesium tholeiitic to calc-alkalic basalts, contain higher aluminum, lower titanium than other basalts of the Kidd–Munro assemblage and are similar to primitive N-MORB (*see* "Geochemistry"). Plagioclase-bearing mafic rocks are reported in other parts of the Kidd–Munro assemblage (Berger 2000), however, this is the first place where such rocks form mappable units. Green (1975) reported that plagioclase-bearing rocks may signify a change in bulk chemistry from tholeiitic to calc-alkalic magmatism. The plagioclase-phyric basalts occur near the core of an anticline and may represent the oldest members or an older substrate upon which the Kidd–Munro assemblage was erupted.

Mafic tuff is reported to occur in a few diamond drill logs in the southern part of the Kidd–Munro assemblage near the Pipestone fault. In other parts of the assemblage where structural deformation is pronounced, rocks described in diamond drill logs as "mafic tuff" were observed by the author to be strongly foliated and more properly described

as schist (see below). Jackson and Fyon (1991) indicated that mafic pyroclastic rocks are not abundant in the assemblage.

Graphite breccia is reported in diamond drill logs from southeastern Wilkie Township where it occurs with graphitic argillite and in local shear zones. In this environment graphite and chlorite stringers occur along, as well as crosscutting, foliation planes. Carbonate is not abundant and brecciation commonly crosses contacts between different rock types. Graphite breccia in this environment is inferred to be tectonically derived with graphite, chlorite and less commonly sulphides remobilised into the fault planes. Airborne electromagnetic conductors are coincident with graphite breccia in this part of the map area and were used by Johnstone (1991a) to infer the location of the regional Pipestone fault. However, it is more likely that the electromagnetic conductors are coincident with stratigraphic units and that the Pipestone fault occurs farther south at the Kidd–Munro—Hoyle assemblage contact.

Mafic schist is a descriptive term used to describe dark green, black or grey, strongly foliated rock that may have been derived from a mafic metavolcanic protolith or from some other protolith that was subsequently altered. Unaltered schist derived from a mafic metavolcanic protolith is characterised by chlorite, carbonate, epidote and opaque minerals and is commonly transitional into the less foliated parent rock. This type of mafic schist is most common along the Pipestone fault and in localised shear zones within the Kidd–Munro assemblage. Hydrothermally altered schist derived from a mafic metavolcanic protolith is commonly strongly foliated and composed of carbonate, chlorite, white mica, quartz and epidote. Graphite commonly occurs along foliation planes and accounts for the dark colour of the schist. This type of schist was observed in diamond drill holes at the Montclerg gold deposit.

Reversals in stratigraphic facings of pillows and flow-top brecciation indicate that the Kidd–Munro assemblage is folded about easterly to northeasterly trending axes. The fold pattern is complicated by brittle, north- to northwest-trending faults that locally offset stratigraphy and by northeast-trending axis-parallel shear zones across which the geology is not repeated in the southern part of the assemblage.

BOWMAN ASSEMBLAGE

Mafic metavolcanic rocks comprise most of the Bowman assemblage and are composed predominantly of pillowed flows with lesser massive and pillow brecciated flows. Pillows vary between 60 to 90 cm long by 20 to 40 cm wide, are well to poorly formed, close packed, thin rimmed (1 to 2 cm) and generally contain very little inter-pillow material. Epidote- and calcite-filled amygdules (1 to 5 mm in size) are common and radial pipe vesicles were observed in one well-exposed outcrop along Highway 11 in lot 2, Concession II, Taylor Township.

Fine- to medium-grained massive flows are common and these green to light green rocks commonly contain 10 to 15% pyroxene phenocrysts, now replaced by epidote and chlorite. Individual flow thickness was not determined; however, they appear to be less than 20 m thick for the most part based on a few outcrops where massive and pillowed flows are interbedded. Whole rock geochemistry indicates that these rocks are iron and magnesium tholeiites with higher aluminum and lower titanium than the Kidd–Munro assemblage (*see* "Geochemistry").

Pillow and flow breccia occurs locally as narrow discontinuous units intercalated with pillowed and massive flows. The units are composed of monolithic mafic fragments less than 8 cm in size and are generally no more than a few metres thick.

Mafic schist is most common within the Porcupine–Destor deformation zone where it occurs as a fine-grained green to black rock with well-developed foliation planes. Hydrothermally altered mafic schist is described in Carr Township where diamond drilling for gold mineralisation has tested several parts of the Porcupine–Destor deformation zone. Schist is very similar to that described in the Kidd–Munro assemblage and the hydrothermal mineral assemblage contains hematite in addition to white mica, quartz and carbonate.

Stratigraphic facings are mostly southward younging in the Bowman assemblage and rock units are shallow southward dipping (30 to 60°) as is the Porcupine–Destor deformation zone. These data imply that the Bowman

assemblage was thrust over the Hoyle assemblage, an interpretation supported by geophysical data west of the map area (Spector 1994; Siragusa 1993).

Intermediate Metavolcanic Rocks

Intermediate metavolcanic rocks occur in the Kidd–Munro and Duff–Coulson–Rand assemblages. Massive, pillowed and brecciated andesite and dacite flows of the Kidd–Munro assemblage underlie western Clergue Township and are spatially associated with komatiitic metavolcanic rocks and the Dundonald Sill. Intermediate pyroclastic and epiclastic metavolcanic rocks occur in the Duff–Coulson–Rand assemblage where they are interbedded with clastic metavolcanic rocks.

DUFF–COULSON–RAND ASSEMBLAGE

Heterolithic lapilli tuff and tuff breccia were observed in two widely separated sonic drill cores from Clergue and Wilkie townships. Subangular to subrounded andesitic clasts that contain pyroxene and plagioclase phenocrysts occur in an ash matrix. The clasts are strikingly similar to intermediate metavolcanic rocks observed in Little Township that the author correlated with the Duff–Coulson–Rand assemblage (Berger 2000). The intermediate rocks in the map area are associated with low intensity airborne magnetic patterns and weakly conductive airborne electromagnetic anomalies. This is similar to the Duff–Coulson–Rand assemblage in Little and Tully townships where clastic metasedimentary rocks are interlayered with the intermediate metavolcanic rocks. Similar interlayering of metasedimentary and intermediate metavolcanic rocks is inferred in the map area.

KIDD–MUNRO ASSEMBLAGE

Intermediate metavolcanic rocks are exposed in a number of outcrops and reported in several diamond drill holes in western Clergue Township. These rocks are composed of andesitic and dacitic massive pillowed and pillow brecciated flows with subordinate tuff breccia and lapilli tuff. Massive flows form thickly stacked flow units in lot 12, Concession III, Clergue Township and are characterised by white to lime green weathered surfaces that commonly display contorted flow laminations, flow breccia and spherulites. Individual flows are generally less than 3 m thick, although some are over 10 m thick. Thin, discontinuous units of flow breccia and pillowed flows occur between massive units. The intermediate flows are contiguous westward into Dundonald Township where they are interlayered with ultramafic komatiitic flows. In thin section these rocks typically contain abundant microlitic plagioclase and epidote; there is very little quartz. Whole rock geochemistry indicates that the massive flows are calc-alkalic andesite and dacite with low silica (up to 60%), high aluminum (16 to 19%) and high titanium (1.2%) content (*see* "Geochemistry").

Andesitic pillowed flows and pillow breccia are common and are characterised by well to poorly formed pillows between 60 to 100 cm long by 20 to 40 cm wide and rims up to 2 cm thick. Pillowed flows are close packed or may contain significant amounts of interpillow hyaloclastite and flow breccia. Pillowed flows commonly pass laterally and vertically into isolated pillows and pillow breccia (Carlisle 1963) that locally form units up to 25 m thick.

Intermediate to felsic tuff breccia, lapilli tuff and tuff are reported in diamond drill logs, however the author did not observe these rock types. Descriptions of the fragmental rocks leads the author to speculate that pillow and flow breccia may have been mistaken in drill core for pyroclastic rocks.

The Kidd–Munro assemblage is largely bimodal, composed of mafic/ultramafic and felsic metavolcanic rocks (Jackson and Fyon 1991; Bleeker et al. 1995). The interbedded plagioclase-bearing flows within the mafic metavolcanic rocks (see above) and the intercalation of ultramafic flows with the intermediate rocks indicate that the latter are part of the stratigraphy and have not been tectonically interleaved with the Kidd–Munro assemblage. These data signify that volcanism was different in this part of the assemblage than elsewhere. The Kidd–Munro

assemblage, therefore, is not simply bimodal along its strike and different magma sources and chambers were tapped to produce the assemblage.

Felsic Metavolcanic Rocks

Felsic metavolcanic rocks occur in the Duff–Coulson–Rand and Kidd–Munro assemblages and are composed of massive and laminated flows, flow breccia and hyaloclastite, pyroclastic tuff, lapilli tuff and tuff breccia. Felsic schist, graphite breccia and spherulitic varieties are locally abundant.

DUFF–COULSON–RAND ASSEMBLAGE

Felsic metavolcanic rocks comprise approximately 5% of the Duff–Coulson–Rand assemblage and underlie the northern parts of Walker and Wilkie townships. These rocks are known only from diamond and sonic drill core and are composed mostly of fragmental rocks and schist. Felsic flows are minor.

The felsic rocks contain quartz and feldspar phenocrysts (1 to 5 mm) and are white, grey, pale yellow and purplish red where they are hematized. Fragmental rocks consist of heterolithic pyroclastic and epiclastic tuff, lapilli tuff and tuff breccia. Subrounded to subangular fragments in tuff breccia are composed mainly of quartz-feldspar porphyry with lesser amounts of cherty, sulphiditic clasts and aphanitic mafic clasts up to 50 cm in size; however, most clasts average 6 to 8 cm. Planar and less commonly graded-bedded tuff and lapilli tuff are interbedded with the coarser fragmental rocks and in many places graphitic argillite and schist are present.

Felsic flows are rare and, where observed, form thin discontinuous units that are quartz phyric and flow laminated. Flow brecciated units are present locally and fragments of flows occur within some of the felsic pyroclastic and epiclastic deposits described above.

Felsic schist is characterised by fine-grained, strongly foliated rock that contains abundant quartz, beige to yellow sericite and brown carbonate. Quartz-sericite schist was encountered in several closely spaced sonic drill holes in lot 2, Concession V, Walker Township and core from these holes contain pyrite and purple fluorite indicative of hydrothermal alteration. The abundance of schist indicates that much of the felsic rocks are sheared in the Duff–Coulson–Rand assemblage. A major easterly trending shear zone is interpreted by the author to mark the contact between the Duff–Coulson–Rand and Kidd–Munro assemblages based on the abundance of schist and geophysical data.

The Duff–Coulson–Rand felsic rocks are geochemically characterised as calc-alkalic dacite and rhyolite that display negatively sloping rare earth element patterns similar to F-I felsic rocks (Lesher et al. 1986). These geochemical trends are generally not conducive to volcanogenic base metal mineralisation (Lesher et al. 1986; Barrie et al. 1993), however, the abundance of sericite, carbonate, pyrite and schist indicate that there is potential for structurally controlled gold mineralisation with these rocks. As there has been little exploration in this part of the map area the gold potential has not been thoroughly tested.

KIDD–MUNRO ASSEMBLAGE

Felsic metavolcanic rocks comprise approximately 10% of the assemblage and are composed mainly of massive flows and flow breccia with subordinate lapilli tuff and tuff. The felsic rocks occur in two units each up to 500 m thick that extend discontinuously across the southern part of the assemblage (*see* Map P.3367, back pocket). The two bands may represent the opposite limbs of a fold as inferred in southern Clergue Township; however, there are no reversals in stratigraphic facings in southern Wilkie and Walker townships and it is possible that here the two felsic bands are structurally repeated. Quartz-feldspar equigranular and porphyritic tonalite that occurs in the vicinity of the felsic metavolcanic rocks are inferred by the author to be subvolcanic intrusions and are described below.

Massive and laminated flows are exposed in lots 6 and 7, Concession I, Clergue Township and are characterised by white weathered surfaces that display convoluted and parallel flow laminations, millimetre-sized spherules, 1 to 7 mm quartz-filled amygdules, and rubbly brecciated flow tops. Individual flows vary between 60 cm and 10 m thick and most display a massive base that progresses up-section into a flow-laminated portion and an autoclastic flow-brecciated top. Chlorite and epidote concentrations at the tops of some flows impart a green to rusty red hue to the rocks and serve as a method for rapid identification of flow units. Massive flows in lot 6, Concession I, Walker Township occur as discontinuous lenses of pale white, densely spherulitic rock that is green to black on fresh surface. Just north of this area felsic flows in drill core are white to grey, densely quartz phyric and are fine to medium grained. Massive flows also occur in drill core in southwestern Wilkie Township where they vary from pale grey to green-grey due to pervasive hydrothermal chloritization that makes them look superficially like intermediate metavolcanic rocks. The felsic flows are quartz phyric however, which serves to distinguish them from other rock types. In thin section massive flows contain subhedral quartz and less commonly euhedral plagioclase phenocrysts in fine-grained to cryptocrystalline groundmass composed of quartz and plagioclase. In many samples plagioclase and less commonly quartz displays fan-like extinction under polarised light which the author interprets to result from rapid cooling of the flows (Photo 1).

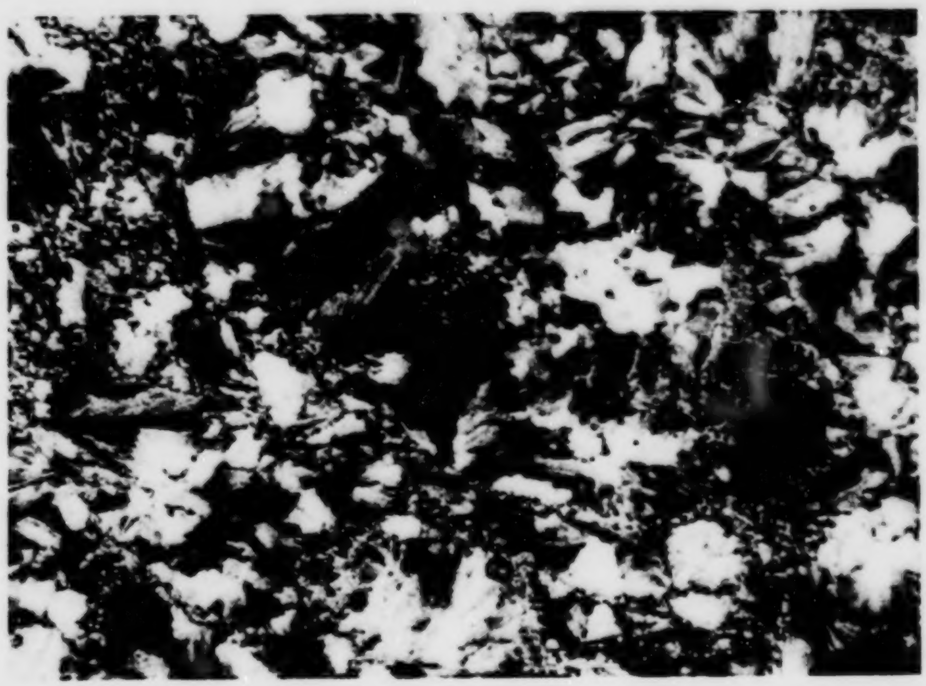


Photo 1. Fan extinction on plagioclase in F-III rhyolite is interpreted to result from rapid cooling of the flow (field of view is 4 mm).

Autoclastic and flow-top breccia commonly occurs as thin discontinuous units with massive flows and in some areas forms stacked flow units several metres thick. These rocks are generally darker than massive flows due to higher amounts of chlorite and epidote in the groundmass. Angular to subrounded monolithic felsic flow fragments (1 mm to 5 cm), many of which are laminated, occur in a fine-grained to cryptocrystalline quartzofeldspathic groundmass. Fan-like plagioclase and quartz interpreted to result from rapid cooling were observed in polarised light in several thin sections.

Heterolithic lapilli tuff and less commonly tuff was observed in the southwestern part of Wilkie Township where they are interlayered with massive and autoclastic flows. The fragmental rocks are heterolithic, predominantly with felsic metavolcanic fragments and rarely with dark green mafic or ultramafic fragments up to 3 cm in size. The deposits are clast to matrix supported; however, these rocks commonly display high strain that masks their field relationships with other rocks. In addition, the felsic rocks have undergone extensive chloritization and sericitization that further obscures the rocks in this area.

Major oxide geochemistry indicates that the Kidd–Munro assemblage felsic metavolcanic rocks are tholeiitic to calc-alkalic dacites and rhyolites with higher SiO_2 and lower TiO_2 than felsic metavolcanic rocks in the Duff–Coulson–Rand assemblage. Significant trace element differences between rocks of the two assemblages include higher Zr and Y, and higher total REE in the Kidd–Munro assemblage. The Kidd–Munro felsic rocks can be further subdivided into two categories based solely on REE patterns.

One group of felsic rocks display relatively flat REE patterns at or above 100 times chondrite levels with a pronounced Eu depletion. This pattern is similar to F-IIIb rhyolites described by Lesher et al. (1986) and are similar to REE patterns of felsic rocks at the Kidd Creek base metal mine (Barrie et al. 1993). The second group of felsic rocks display REE patterns with slightly depleted heavy REE and a less pronounced Eu depletion than group 1 felsic metavolcanic rocks of the Kidd–Munro assemblage. These rocks compare closely with F-II type rhyolites (Lesher et al. 1986). The F-II rhyolites occur only east of the Black River in southern Wilkie Township where they appear to be intimately mixed with the F-III rhyolites. Mineral exploration in this area encountered hydrothermal alteration (chloritization, sercitization and silicification) which may account, in part, for the REE patterns.

Metasedimentary Rocks

Clastic metasedimentary rocks are predominant in the Hoyle assemblage, and comprise a significant portion of the Duff–Coulson–Rand assemblage. They occur as interflow units in the eastern and southern parts of the Kidd–Munro assemblage. Wacke and siltstone are most common; argillite and graphitic argillite is locally abundant; schist, conglomerate and chert are rare.

DUFF–COULSON–RAND ASSEMBLAGE

Metasedimentary rocks in the Duff–Coulson–Rand assemblage are composed of lithic wacke, graphitic argillite, siltstone and derived schist and are known only from a few scattered drill cores. The metasedimentary rocks appear to be interbedded with felsic and intermediate metavolcanic rocks that display similar airborne magnetic patterns (OGS 1984a-c). The distribution and proportion of metasedimentary rocks may be much less than portrayed on Map P.3367; however, metasedimentary rocks in this map area are postulated to be extensive based on relationships with map areas to the east and west (Muir 1995a; Johnstone 1991).

Medium-grained lithic wacke was observed in drill core in lots 1 and 3, Concession VI, Clergue Township where the unit is interbedded with graphitic argillite and siltstone. Grain gradation, load casts and ripped up argillite clasts were observed in beds varying between 1 and 30 cm thick. Many of the wacke beds were capped with thin argillite or siltstone and these features are characteristic of turbidite deposition (Walker 1992). Quartz and plagioclase comprise most of the detrital grains and metasedimentary and mafic lithic clasts are minor. White mica, carbonate, graphite and very-fine-grained quartz comprise the matrix which makes up approximately 25 to 35% of the rock.

Siltstone and schist were observed in sonic drill core from northeastern Wilkie Township and here the metasedimentary rocks are deeply weathered and strongly schistose. Metasedimentary rocks immediately east in Coulson Township are correlated with those in the map area and readers are referred to Leahy and Ginn (1962) and Johnstone (1991b) for additional information. Siltstone from one sonic drill hole in lot 2, Concession V, Wilkie Township displayed elevated potassium and arsenic and depleted sodium indicative of hydrothermal alteration (OGS

1988a). Johnstone (1991b) observed that metasedimentary rocks in southern Coulson Township are commonly carbonatized and silicified suggestive that the alteration is widespread. The combination of strained and hydrothermally altered rocks indicates that the metasedimentary rocks are prospective for gold mineralisation.

KIDD–MUNRO ASSEMBLAGE

Clastic and chemical metasedimentary rocks composed predominantly of graphitic and pyritic mudstone and less commonly wacke comprise less than 5% of the Kidd–Munro assemblage and most commonly occur as narrow discontinuous units between metavolcanic flows. Graphitic argillite is most common in the vicinity of the felsic metavolcanic rocks in Wilkie and Walker townships and many of the drill-tested electromagnetic conductors are correlated with narrow unmappable units of graphitic argillite. Wacke, siltstone and rare pebble conglomerate occur with graphitic argillite in east-central Wilkie Township where they are interbedded between mafic and ultramafic metavolcanic rocks. The absence of thick metasedimentary units indicates that volcanism was predominant throughout the Kidd–Munro assemblage.

HOYLE ASSEMBLAGE

Clastic metasedimentary rocks of the Hoyle assemblage underlie the central and northern parts of Taylor and Carr townships and form an easterly trending band up to 6 km wide. Siltstone, argillite and wacke are exposed in a few outcrops in eastern Carr Township where beds average 5 to 8 cm thick (maximum 60 cm thick), are planar bedded and ungraded. These outcrops display a moderate to strong foliation as they occur near the inferred location of the Pipestone fault and primary structures such as grain gradation and load casts are poorly preserved. Metasedimentary rocks observed in diamond and sonic drill core in several widely scattered drill holes are composed predominantly of siltstone with lesser wacke and mudstone. In these places grain gradation, ripped up mudstone clasts, load casts and rare convolute bedding indicate deposition by turbidity currents, and the predominance of fine-grained detritus and thin beds indicate a deep-water environment distal from source. Farther west the Hoyle assemblage displays thicker beds, coarser detritus and more massive bed forms indicative of an environment closer to source (Berger 1994, 1999). The Hoyle assemblage is characterised by low intensity airborne magnetic patterns and low conductivity as indicated by the absence of strong electromagnetic conductors (OGS 1984d, 1984e). The locations of diabase dikes and calc-alkalic quartz-feldspar intrusions are easily discerned as these rocks display higher magnetic relief than the surrounding metasedimentary rocks.

The depositional age of the unit is constrained by a detrital zircon U-Pb absolute age of 2699 Ma derived from metasedimentary rocks correlated with the Hoyle assemblage near the Kidd Creek Mine (Bleeker et al. 1996; Heather et al. 1995). This age, if applicable to the entire Hoyle assemblage, indicates that the metasedimentary rocks are significantly younger than any of the metavolcanic assemblages in the map area. Bleeker et al. (1996) indicate that young felsic metavolcanic rocks such as the Blake River group or Krist assemblage were a likely provenance for the bulk of the detritus; however, Born (1995) argued that a continental source southwest of the map area was the major provenance. The facies distribution indicates that the metasedimentary rocks become finer grained and more thinly bedded farther east in the assemblage indicating a westerly source. This precludes the Blake River group as a source terrane, as it is mainly southeast of the map area. Turbiditic rocks in the Porcupine syncline at Timmins directly overlie the felsic metavolcanic Krist assemblage and felsic metavolcanic rocks are interbedded with the Hoyle assemblage in Murphy and Wark townships north of Timmins (Berger 1999). This indicates that reworking of felsic metavolcanic rocks could have contributed much of the detritus in the Hoyle assemblage.

Metasedimentary rocks are tectonically interleaved with ultramafic rocks of the Bowman assemblage in the Porcupine–Destor deformation zone. Schist is most abundant however wacke, siltstone and graphitic argillite were observed locally to be well preserved. Metasedimentary rocks east of the Taylor Mine in lot 4, Concession III, Taylor Township display laminated to thin beds, grain gradation and load casts which the author interpreted to represent distal facies turbidites of the Hoyle assemblage. Metasedimentary rocks host the Shoot Zone gold deposit in lot 9, Concession II, Taylor Township and are described by Worden et al. (1995) as "Porcupine Group turbiditic

metasediments" which are correlative with the Hoyle assemblage. Shegelski (1989) observed that metasedimentary rocks at the Shoot Zone displayed primary structures more compatible with shallow-water tidal channel, delta or estuary deposits. This is important because such deposits are known to occur only with the Timiskaming-like Three Nations assemblage which is 2679 Ma (Jackson and Fyon 1991). Gold mineralisation is associated with the Three Nations assemblage but not with Hoyle assemblage in the Timmins area and this suggests that it may be critical to distinguish between the two assemblages in future exploration programs in the map area.

Felsic Subvolcanic Intrusive Rocks

Felsic intrusive rocks composed of tonalite and trondjhemite occur in the Kidd–Munro assemblage. Prest (1951a) mapped a "granitic" intrusion extending from lot 3 to lot 8, Concession I, Wilkie Township and noted that erratic low-grade gold mineralisation was associated with it. A tonalite outcrop of this intrusion examined by the author contained coarse-grained, equigranular opalescent quartz and pink feldspar with 10 to 15% intercrystalline chlorite and epidote. Whole rock and REE geochemistry display very similar patterns to felsic extrusive rocks approximately 6 km northwest and on this basis the tonalite is inferred to represent a subvolcanic intrusion which probably provided magma for the nearby extrusive rocks.

The Montclerg gold deposit in lot 1, Concession I, Clergue Township is hosted in a felsic porphyritic rock described as intrusive porphyry or felsic fragmental (Malczak 1986). Diamond drill core examined microscopically by the author contained euhedral quartz and plagioclase phenocrysts in a vari-textured groundmass of quartz, plagioclase and 10 to 20% chlorite and epidote. Many of the quartz phenocrysts are surrounded by a ring of cryptocrystalline quartz and much of the groundmass plagioclase displays fan-like extinction in polarised light indicative of rapid cooling. The contacts of the felsic rocks are highly strained and the author has interpreted them to be intrusive. The felsic rocks at the Montclerg gold deposit contain high SiO_2, Zr and Y similar to flow-laminated felsic rocks in lots 3, 6 and 7, Concession I, Clergue Township and on this basis are inferred to be part of a coeval subvolcanic intrusion.

Ultramafic and Mafic Intrusive Rocks

DUNDONALD SILL

Part of the Dundonald Sill underlies western Clergue Township and extends into adjoining Dundonald Township. Naldrett and Mason (1968) and Green and MacEachern (1990) described in detail the geology and petrology of the sill and readers are referred to these sources for details. This section will concentrate on describing that part of the sill within the map area.

Peridotite, pyroxenite and anorthositic gabbro are exposed in a series of small outcrops in lot 10, Concession IV, Clergue Township. Strongly magnetic, coarse-grained, black peridotite occurs at the base of the sill and in one outcrop discontinuous magnetite-rich and -poor layers 3 to 5 cm thick were observed. In thin section the magnetite-poor layers display up to 60% equant olivine variously altered to magnetite and serpentine with minor intercumulate pyroxene. Locally, pyroxene formed clumps and thin discontinuous bands in the rock. Medium- to fine-grained, green pyroxenite was observed to overlie the peridotite. The pyroxenite is generally more homogeneous than the peridotite and primary igneous layering was not observed. Euhedral and prismatic clinopyroxene crystals comprising up to 85% of the rock were observed in thin section to be contained within intercumulate, saussuritized plagioclase. Anorthositic gabbro pods and lenses occur within the pyroxenite close to the contact with intermediate metavolcanic rocks. This light green to green weathering rock is composed of very-coarse-grained pyroxene and plagioclase in approximately equal proportions. Anorthositic gabbro appears to occur locally and is commonly an unmappable phase of the sill.

Gabbro, exposed in lot 11, Concession IV, Clergue Township is dark green, medium-grained and moderately magnetic. It is generally massive; however, locally pegmatitic plagioclase- and chlorite-bearing veins were observed

to crosscut the gabbro. Subophitic plagioclase, pyroxene and minor quartz comprise the bulk of the mineralogy with accessory white mica, epidote, chlorite and magnetite. Peridotite, pyroxenite and gabbro units within the Dundonald Sill are reported in diamond drill logs from lots 8 to 12, Concessions I and II, Clergue Township where they are interleaved with komatiitic, intermediate and felsic metavolcanic rocks.

The Dundonald Sill is strongly magnetic and overwhelms the geophysical responses of the host metavolcanic rocks on total field magnetic maps (OGS 1984a). Second vertical derivative magnetic maps provide better resolution of the sill and these data were used to trace the limits of the sill on Map P.3367. A number of strong and moderate electromagnetic conductors are spatially associated with the sill and where drill-tested have proved to be caused by graphite and lesser amounts of massive and disseminated copper, zinc and nickel sulphides. There appears to be untested mineral potential in lot 9, Concession II and III and in lot 10, Concession III, Clergue Township.

Massive peridotite and ultramafic schist occur in lots 7 to 9, Concession II, Carr Township within the Porcupine–Destor deformation zone. It is possible that these rocks represent cumulate portions of komatiitic flows, however, they were interpreted to be intrusive rocks based on their massive character.

Felsic and Intermediate Intrusive Rocks

Quartz-feldspar porphyry stocks intruded the Hoyle assemblage in the central parts of Taylor and Carr townships. The intrusions are known only from drill data and most of these holes are from lot 7, Concession V, Carr Township. Representative porphyry from this area is grey to beige, densely porphyritic with euhedral quartz and albite (3 to 10 mm in size) in a fine-grained quartz-chlorite-white mica-bearing groundmass. Various amounts of hematization, sercitization and silicification have altered the porphyry over wide intervals in the drill core and accompany porphyry-style disseminated and stringer chalcopyrite, pyrite and quartz-vein-hosted gold mineralisation. Whole rock geochemistry indicates the porphyry is calc-alkalic with 66 to 67% silica and high sodium (5.5 to 7%). REE patterns display patterns similar to F-I type felsic rocks (Lesher et al. 1986); however, total REE are much lower than observed in representative F-I rhyolite indicating magma generation in a depleted mantle. Morphologically and geochemically similar porphyritic rocks were observed in Gowan Township where they intruded ultramafic and metasedimentary rocks and are associated with copper-zinc mineralisation (Berger 1992).

Quartz-feldspar porphyry was encountered in widely spaced sonic drill holes sunk by the Ontario Geological Survey in Carr and Taylor Townships (Jensen and Baker 1986). These rocks are green, foliated and display more carbonate and chlorite alteration than the porphyry described above. Quartz phenocrysts are generally anhedral to subhedral and a few display diffuse contacts with the groundmass that is interpreted as resorption texture. Plagioclase is white due to incipient white mica alteration; however, phenocrysts generally retain their euhedral shape and albite twinning. The groundmass is composed mainly of secondary chlorite, quartz and fine-grained anhedral carbonate. This type of porphyry is inferred to be a phase of the same intrusion as described above where it occurs in Carr Township based on geophysical data. Quartz-feldspar porphyry in central Taylor Township may represent a satellite intrusion or an apophysis of the Carr Township intrusion.

The delineation of the felsic intrusions on Map P.3367 is based on drill hole and geophysical data. The porphyritic rocks display higher magnetic susceptibility than the host metasedimentary rocks of the Hoyle assemblage; in Carr Township an intrusion covering approximately 11 km^2 is inferred. This intrusion has imparted a contact metamorphic aureole on the host metasedimentary rocks as indicated by chlorite, white mica and carbonate porphyroblasts in drill core from lot 8, Concession V, Carr Township. These porphyritic rocks are, therefore, younger than the 2699 Ma Hoyle assemblage and may be temporally related to the 2690 Ma porphyry stocks in the Timmins area (Jackson and Fyon 1991). The quartz-feldspar porphyry was only recently discovered in 1982 as part of a regional gold exploration program by Canamax Resources Incorporated. The full extent of the porphyry and mineralisation is untested and this is here interpreted to indicate that the entire Hoyle assemblage is prospective for porphyry-style copper and gold mineralisation.

Feldspar-porphyritic dikes that contain minor quartz phenocrysts intrude the Bowman assemblage along the Black River in Carr Township. These dikes are grey to pink weathering with 35 to 40% white plagioclase phenocrysts (2 to 5 mm), less than 5% quartz phenocrysts and 15 to 20% mafic phenocrysts which are comprised of secondary epidote. The groundmass is composed of very-fine-grained quartz, plagioclase and epidote. The mineralogy and morphology of these porphyry dikes is not similar to the quartz-feldspar porphyry in the Hoyle assemblage. The concentration of these dikes at the south edge of the map area suggests that they were derived from granitic rocks to the south. Leahy (1964) mapped numerous feldspar porphyry dikes in Bowman Township and these dikes tend to increase as the Watabeag granitic batholith is approached.

Tonalite/trondjhemite dikes and sills intruded ultramafic, mafic and metasedimentary rocks within the Porcupine–Destor deformation zone. Representative samples from the waste dump of the Porphyry Zone gold deposit in Taylor Township are white weathering, medium grained, equigranular and display relatively little strain. In thin section this rock is composed of approximately 80% albite, 5% quartz with the rest composed of intercrystalline carbonate, white mica and pyrite. Major oxide geochemistry shows that the tonalite contains approximately 10% sodium and high aluminum indicating alkaline geochemical affinity. Alkalic intrusive rocks associated with gold mineralisation are common east of the map area (Jensen and Langford 1985). Worden et al. (1995) indicated that a variety of alteration styles and deformation affected the trondjhemite including a phosphate-rich phase which marks the structural footwall to the gold mineralisation. The author collected a sample of carbonatized trondjhemite with large red apatite crystals and petrographic examination revealed that large fractured zircon crystals were contained in the apatite and within the carbonate. These observations generally concur with those of Worden et al. (1995).

Feldspar- and quartz-porphyritic tonalite occurs south and west of the Shoot Zone gold deposit and was observed in sonic drill core by the author. The tonalite is petrographically similar to that at the Porphyry Zone except that albite and less commonly quartz phenocrysts up to 5 mm in size are present. In one thin section, myrmekitic plagioclase and quartz intergrowths were common, indicative of metasomatism (Deer et al. 1966). Diorite composed of calcic plagioclase and actinolite with minor accessory quartz was observed southeast of the Shoot Zone and this suggests that multiple phases of intrusion are present. Petrographically similar diorite was observed to be peripheral to tonalitic rocks in Evelyn and Gowan townships and the author infers that intrusions in the map area are similar to this area (Berger 1992, 1994).

PALEOPROTEROZOIC

Mafic Intrusive Rocks (Quartz Diabase)

A number of north- to northwest-trending diabase dikes correlated by Osmani (1991) with the Paleoproterozoic Matachewan swarm have intruded all assemblages in the map area. Diabase dikes were encountered in several drill data and are fine- to medium-grained, equigranular, dark green to black rocks. Plagioclase phenocrysts (up to 2 cm) are common in the Matachewan dikes however not all dikes contain phenocrysts. In thin section, representative samples of the dike swarm were composed of approximately 40 to 50% plagioclase (An_{37-43}) and 30 to 35% clinopyroxene with minor quartz, magnetite and apatite. Secondary minerals such as white mica, epidote, chlorite and rarely biotite are present in dikes that have been metamorphosed by the Keweenawan olivine diabase (see below). The Matachewan dikes are generally easy to trace aeromagnetically where they intruded less magnetic rocks such as in the Hoyle and Duff–Coulson–Rand assemblages; however, they are difficult to trace where they intruded magnetic ultramafic rocks. The dikes are generally undeformed, weakly altered and intruded along pre-existing structures, most commonly along north- and northwest-trending faults. The Matachewan dike swarm is approximately 2454 Ma (Osmani 1991) and is inferred to be younger than gold mineralisation because one such dike cuts the porphyry gold deposit in Taylor Township. Dikes are probably more numerous than indicated because only the largest and most strongly magnetic ones are portrayed on Map P.3367 (back pocket).

KEWEENAWAN

Mafic Intrusive Rocks (Olivine Diabase)

Northeast-trending olivine diabase dikes correlated with the Abitibi swarm (Osmani 1991) intrude all rock types in the map area. These medium- to coarse-grained dikes are generally deeply weathered and friable, brown, orange-brown to pink and are magnetic. In thin section, subophitic textured plagioclase (An_{45-57}), olivine and pleochroic Ti-rich (?) pyroxene comprise the essential mineralogy; magnetite, apatite and rare biotite are accessory minerals. They are remarkably similar to Keweenawan diabase sheets the author has observed in the Lake Nipigon area of Northwestern Ontario. Osmani (1991) reported that the Abitibi dike swarm was dated at 1140 Ma which makes them the youngest Precambrian rocks in the map area. Members of the Abitibi dike swarm are the most prominent magnetic features in the Monteith map area. Individual dikes display very high magnetic susceptibility and can be followed continuously across the map area. The dikes are dextrally refracted where they cross the Porcupine–Destor deformation zone and the Pipestone fault, which suggests that the regional deformation zones offset the structures exploited by the Abitibi dikes.

CENOZOIC

Quaternary

PLEISTOCENE AND HOLOCENE

The surficial Quaternary geology of the map area is summarised by Richard and McClenaghan (1985). Aerially extensive deposits of glaciolacustrine clay and organic deposits cover most of the area. Fine- to coarse-grained sand and stratified drift draped over bedrock are locally present in parts of Clergue and Wilkie townships.

The subsurface Quaternary geology is complex and consists of one and possibly two older tills and related sediments overlain by the Matheson Till and glaciolacustrine clays of the Barlow–Ojibway Formation (McClenaghan 1991). The older tills are 1 to 20 m thick and are preserved only in the bedrock depressions. Little is known about their relative ages, however, they are commonly dark grey to greenish, silty to sandy in texture and contain an average of 13% carbonate (McClenaghan 1991). Clay-rich, overconsolidated glaciolacustrine sediments generally overlie older till deposits as do organic-rich sediments informally referred to as the "Owl Creek beds" (McClenaghan 1991).

The Matheson Till is aerially extensive, varies from 1 to 30 m thick and is characterised by grey silt and sand with 5 to 15% clasts composed mostly of mafic metavolcanic rocks from proximal sources and felsic to intermediate plutonic clasts from distal sources (McClenaghan 1991). South to southeasterly ice flow directions are indicated and most glacial striations were oriented between 150 and 190° in the map area.

The Barlow–Ojibway Formation conformably overlies the Matheson Till, varies between 1 to 15 m but is locally up to 75 m thick and is composed of proximal and distal glacial varves (McClenaghan 1991). Leahy (1971) provided additional descriptions of the varved clays and silts southwest of the map area on Nighthawk Lake.

Geochemistry

Seventy-six rock samples, collected by the author, were submitted to the Ontario Geological Survey Laboratory (OGS) in Sudbury and to Swastika Laboratories in Kirkland Lake for geochemical analysis. Funding for 32 samples was provided by Falconbridge Limited, Timmins and their contribution to this report is gratefully acknowledged. Duplicate samples were submitted to the Ontario Geological Survey laboratory in order to compare the results from the two laboratories and analyses are presented in Tables 2 to 5 (*see* "Appendix 1"). Samples with a four number

suffix starting with 63 were analyses submitted to Swastika Laboratories. The major oxides, with the exception of the alkalis, display acceptable variations between the two laboratories. High field strength and rare earth element analyses generally show greater precision from the OGS laboratory than analyses from Swastika Laboratories.

This section will discuss the variation in geochemistry among the various assemblages with emphasis on the mafic and felsic metavolcanic and subvolcanic rocks. Major oxide analyses are plotted on widely accepted discrimination diagrams and compared among them and with geochemistry from other parts of the Abitibi Subprovince. Rare earth element (REE) analyses were carried out on all the rocks and these data are useful for discrimination among the various assemblages and provide some insight into petrogenesis. However, Ta and Hf analyses from the OGS laboratory display inconsistent results on widely accepted petrogenetic discrimination diagrams, especially for the ultramafic and mafic rocks and the author advises caution with the use of these elements. The Hf data are affected by sample dissolution problems whereas the Ta values are affected by an instrumental calibration problem.

KIDD–MUNRO ASSEMBLAGE

Table 2 presents 49 different analyses from various rock types in the Kidd–Munro assemblage including some from the Dundonald Sill in Clergue Township, which are discussed separately below. Figures 1a and 1b demonstrate that the Kidd–Munro assemblage contains ultramafic, mafic, tholeiitic and calc-alkalic intermediate and felsic metavolcanic rocks. Intermediate rocks, represented by andesites, dacites and variolites in Clergue are more abundant in the Monteith area than in other parts of the Kidd–Munro assemblage where a bimodal ultramafic/mafic and felsic distribution is common (Berger 1999; Barrie et al. 1993).

Komatiitic Metavolcanic Rocks

Major oxide geochemistry indicates that the komatiitic rocks are peridotitic and Al-undepleted (Xie et al. 1993; Figure 1b; Table 2). Chondrite normalised REE patterns are slightly LREE depleted or relatively flat; however, they display elevated total REE in contrast to those in Munro Township immediately east of the map area, a result, possibly, of crustal contamination (Xie et al. 1993). A primitive-mantle-normalised extended-element plot shows zirconium determined by XRF and yttrium enrichment for all samples; thorium is enriched in 2 samples and depleted in the other 2 samples (Figure 2a). Thorium-enriched komatiites have a similar extended-element pattern to those in Munro Township, which were derived from a different magma source than the tholeiitic rocks in that area (Xie et al. 1993; Canil 1987). By analogy, the thorium-enriched komatiites and mafic metavolcanic rocks in the Monteith area were derived from different sources. Xie et al. (1993) inferred mantle plume processes formed the Kidd–Munro assemblage komatiite sequences in Munro Township.

The thorium-depleted komatiites are previously unreported in the Kidd–Munro assemblage and are unlike komatiites reported for the Tisdale and Boston assemblages (Xie et al. 1993). The trace element patterns are similar to the plagioclase-phyric basalts described below but it seems improbable that komatiitic magma that fractionates only olivine and pyroxene could give rise to plagioclase-phyric basalts. However, it is probable that the thorium-depleted and -enriched komatiites were derived from different magma sources.

Figure 1 - Major Oxide Geochemistry; Kidd - Munro assemblage

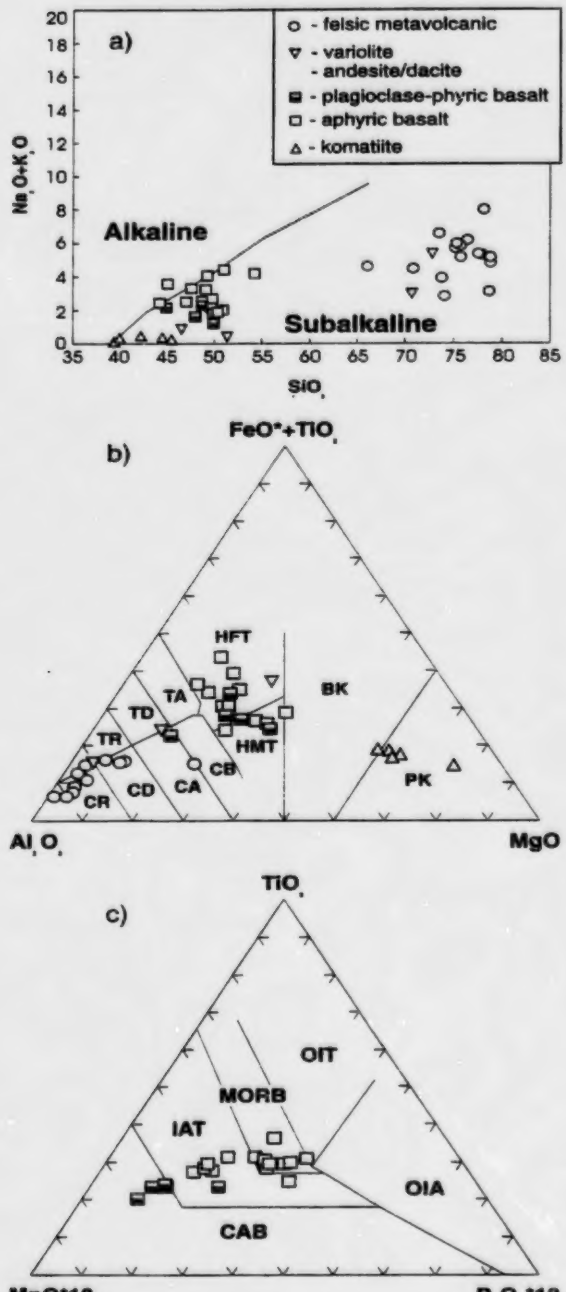
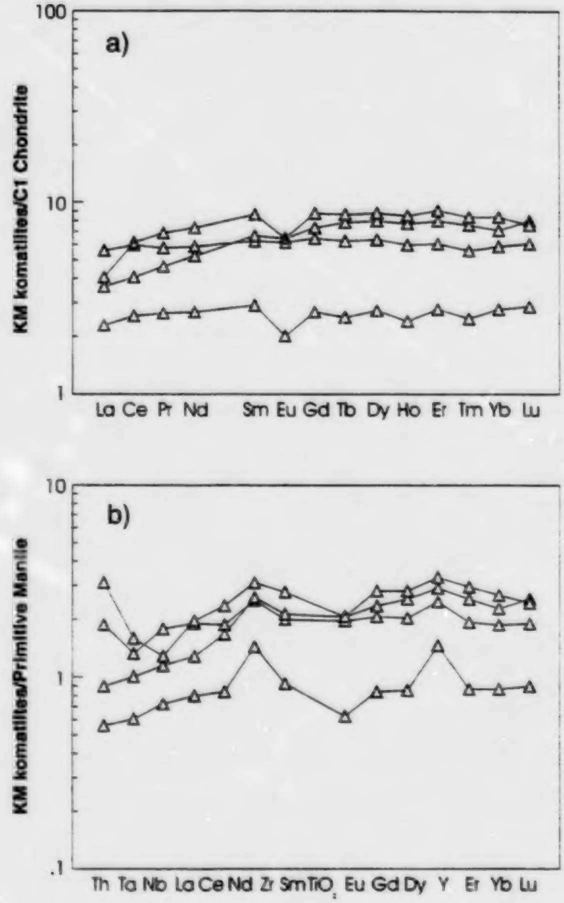


Figure 2 - Komatiite Geochemistry
Kidd - Munro assemblage



Mafic Metavolcanic Rocks

Major oxide data indicates that mafic metavolcanic rocks in the Kidd–Munro assemblage plot as mid-ocean ridge basalts (MORB), island arc tholeiites (IAT) and calc-alkalic basalts (CAB) (Figure 1c). The MORB-like rocks tend to be more concentrated in the southern part, whereas the IAT and CAB mafic rocks are in the central and northern parts of the assemblage. Mafic rocks with higher iron content tend to concentrate in the north and central parts of the assemblage. The plagioclase-porphyritic rocks plot as CAB, indicative of their more alumina-rich geochemistry yet the REE trace element patterns indicate that these rocks are tholeiitic.

Rare earth element (REE) data indicate 2 types of basalts are present in the Kidd–Munro assemblage. The majority of basalts (Type 1) are characterised by relatively flat REE patterns at between 20 and 50 times chondrite (Figure 3a). A small number of samples display slight depletion of the heavy REE and these rocks are correlated with

medium-grained, massive basalt flows. Many samples show slightly negative europium anomalies that are very similar to basaltic rocks in Wark Township north of Timmins (Berger 1999) and in Munro Township east of the map area (Xie et al. 1993). The REE patterns are similar to tholeiitic mid-ocean ridge basalts (MORB) (Pearce 1996). Figure 3b shows that these basalts contain elevated incompatible elements and that they are most similar to transitional-type MORB basalts (Pearce 1996). Such basalts have been interpreted to form from small melt fractions from a melting column under the ridge axis or from the interaction of a mantle plume with ocean ridge processes (Pearce 1996).

The second type of basalt (Type 2) displays depleted light REE (LREE) and more primitive chondrite-normalised patterns than the Type 1 basalts described above (Figure 3c). They are correlated with plagioclase-phyric massive and pillowed flows that are restricted to the central and northern parts of the assemblage in the Monteith area. The REE patterns are similar to N-MORB basalts and indicate derivation from a depleted upper mantle source (Pearce 1996; Kerrich and Wyman 1996). An extended element plot shows only slight Th enrichment and all normalised values are below 1 times MORB (Figure 3d). Further, Type 2 basalts display distinctly lower TiO_2 than Type 1 basalts (Table 2). The plagioclase-phyric basalts are morphologically and geochemically distinct within the Monteith area and have not been reported elsewhere within the Kidd–Munro assemblage. These rocks occur near the core of an anticline in the northern part of the map area and they may be the oldest members of the assemblage or a remnant of an older substrate upon which the Kidd–Munro assemblage was built.

Intermediate Metavolcanic Rocks

Intermediate rocks in the northwest part of Clergue Township are andesite to dacite in composition (Figures 1a, 1b). Rare-earth and extended-element diagrams show that these rocks are enriched in LREE and incompatible elements compared to chondrites and MORB and are likely to represent more fractionated melts of the Type 1 basalt (Figures 4a, 4b). The intermediate rocks extend west in Dundonald Township where they occur in the stratigraphic footwall to the Alexo Cu-Ni deposit. Rocks with similar morphology and REE geochemistry and correlated with the Kidd–Munro assemblage also occur in southwestern Little Township (Berger 2000). These data indicate that intermediate metavolcanic rocks are more common in the Kidd–Munro assemblage than previously recognised (Jackson and Fyon 1991).

Felsic Metavolcanic Rocks

Felsic metavolcanic rocks comprise approximately 10% of the Kidd–Munro assemblage in the map area. Major oxide geochemistry indicates that these rocks are subalkalic, tholeiitic and calc-alkalic, high-silica rhyolites with most SiO_2 values greater than 70% (Figures 1a, 1b). Trace element geochemistry indicates that the felsic rocks can be subdivided into 3 types based on REE and extended-element patterns and abundance.

The first type of felsic metavolcanic rock is characterised by relatively flat REE patterns at approximately 100 times chondrite with a pronounced negative Eu anomaly (Figures 5a, 5c) and negative Nb, Zr and TiO_2 anomalies are also present (Figures 5b, 5d). These patterns are most like the base-metal-bearing felsic rocks at the Kidd Creek Mine and are referred to as F-III rhyolites (Lesher et al. 1986). The F-III rhyolites occur along the southern part of the Kidd–Munro assemblage in the Monteith area extending discontinuously from Clergue to Wilkie townships. Tonalite and quartz-feldspar porphyry intrusions identified by this survey also display F-III rare-earth and extended-element patterns are here considered to represent subvolcanic equivalents (Figures 5e, 5f). F-III rhyolites are considered to be most prospective for Kidd Creek-like base metal mineralisation and these rocks should be thoroughly explored wherever they occur (Lesher et al. 1986; Barrie et al. 1993).

Figure 3 - Basalt Trace Element Geochemistry: Kidd - Munro assemblage

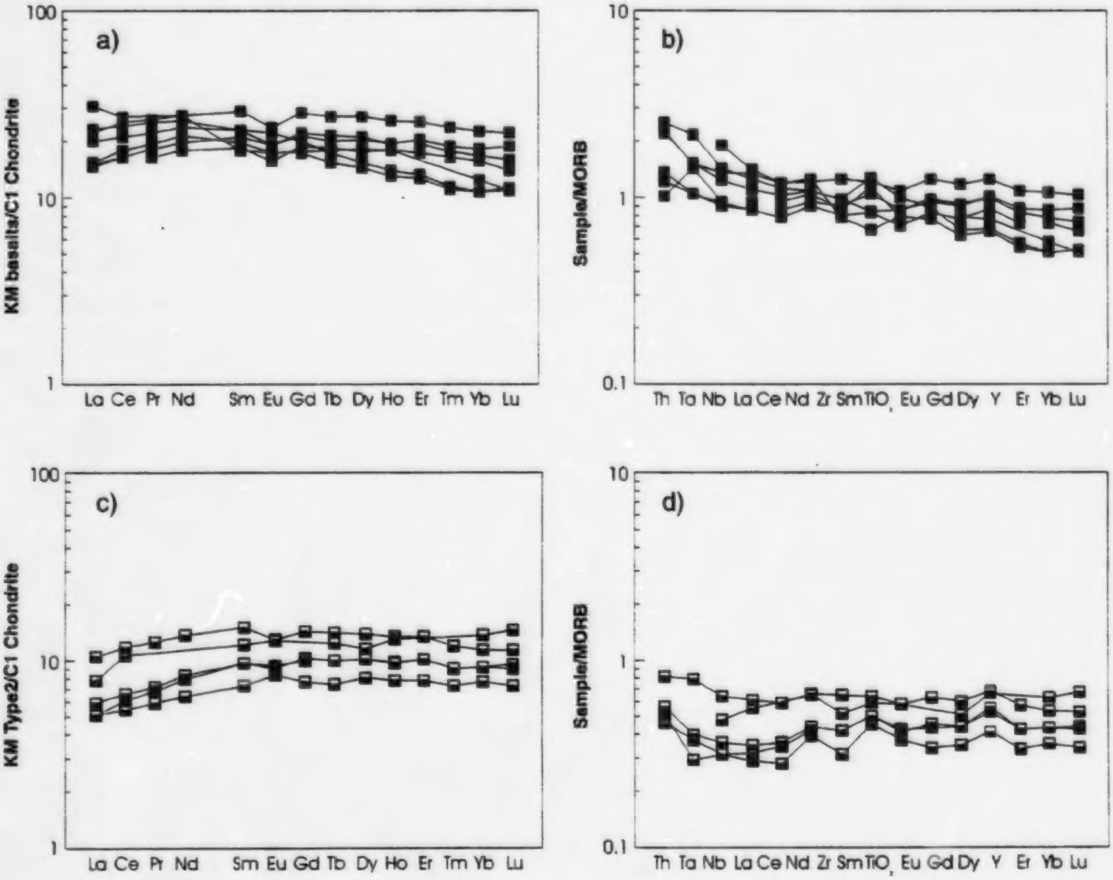


Figure 4 - Intermediate Metavolcanic Rock Geochemistry; Kidd - Munro assemblage

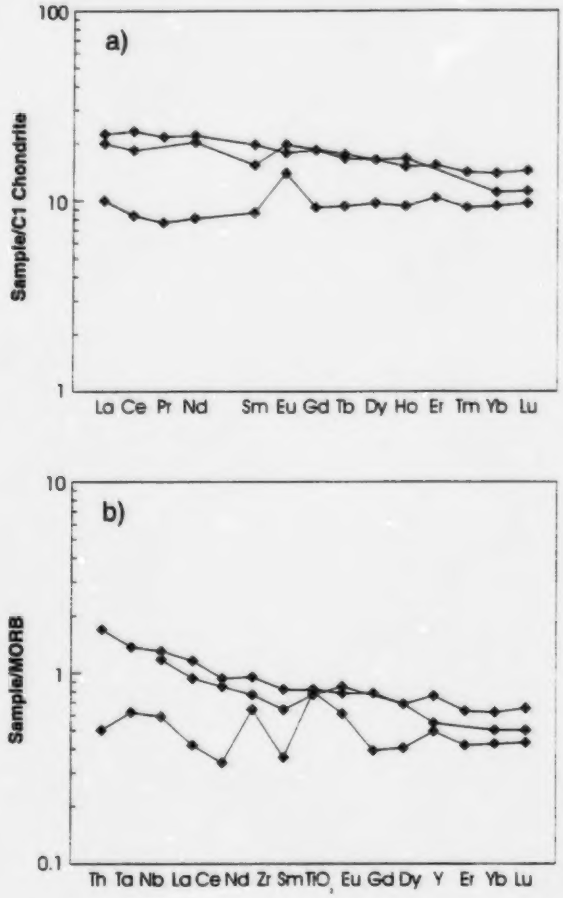
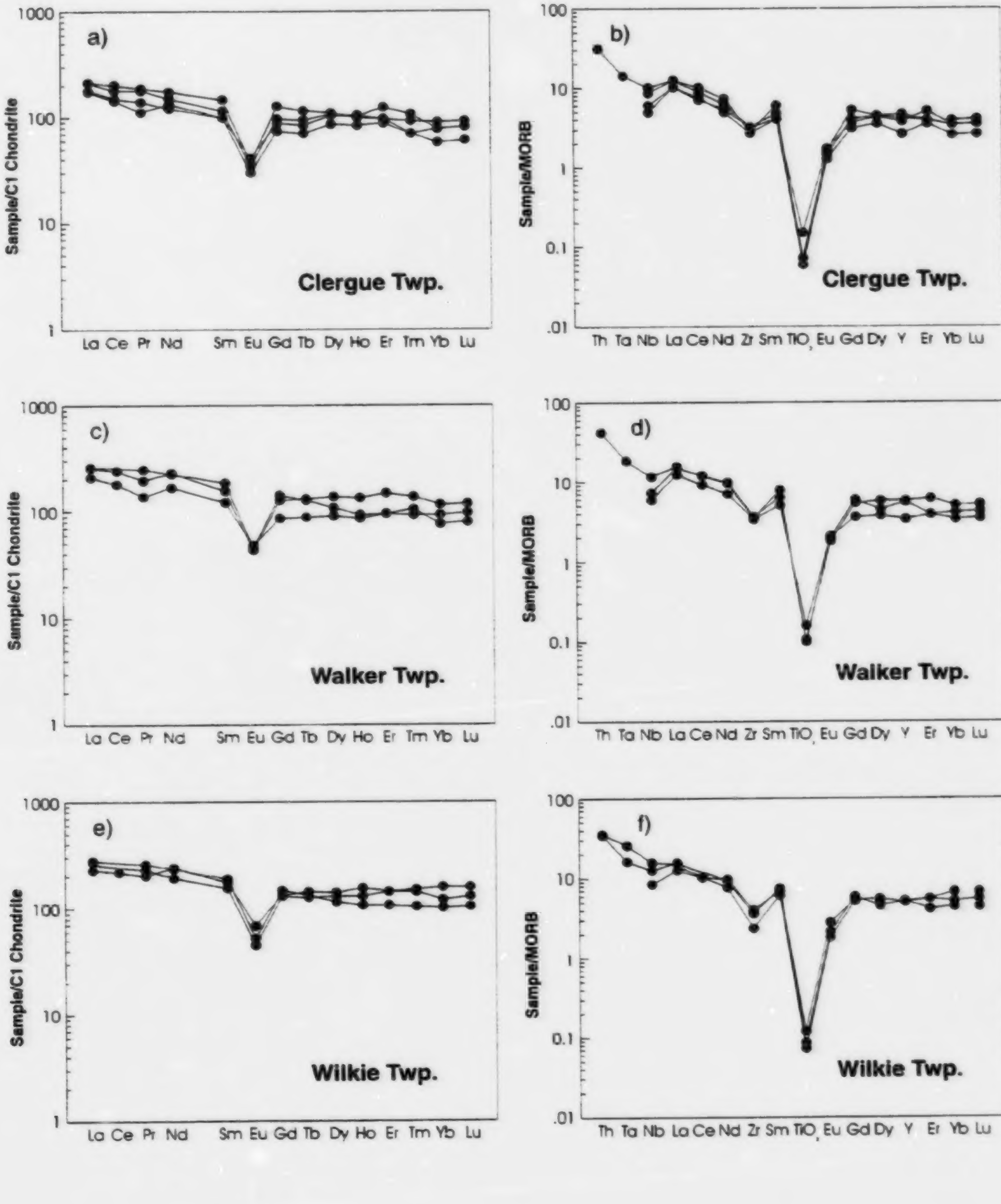


Figure 5 - F-III Felsic Metavolcanic Rock Geochemistry; Kidd - Munro assemblage



The second felsic rock subdivision is characterised by negatively sloped LREE and relatively flat heavy REE (HREE) patterns with only a weak negative Eu anomaly (Figure 6a). Felsic rocks with similar patterns are referred to as F-II rhyolites and occur in association with base metal deposits at Sturgeon Lake, Ontario and Selbaie, Quebec (Lesher et al. 1986; Barrie et al. 1993). A MORB-normalised extended-element plot displays negative Nb and TiO_2 and weakly positive Zr anomalies in contrast to the F-III felsic rocks (Figure 6b).

The F-II felsic rocks are spatially restricted, occurring mainly east of the Black River in the Monteith area. F-III rhyolites and tonalite occur in the same area, but are subordinate to the F-II rocks. Thin sections of F-II felsic metavolcanic rocks contain more white mica and less epidote than F-III rocks that occur in the same vicinity and the F-II felsic rocks also tend to be more pyroclastic in eruptive style.

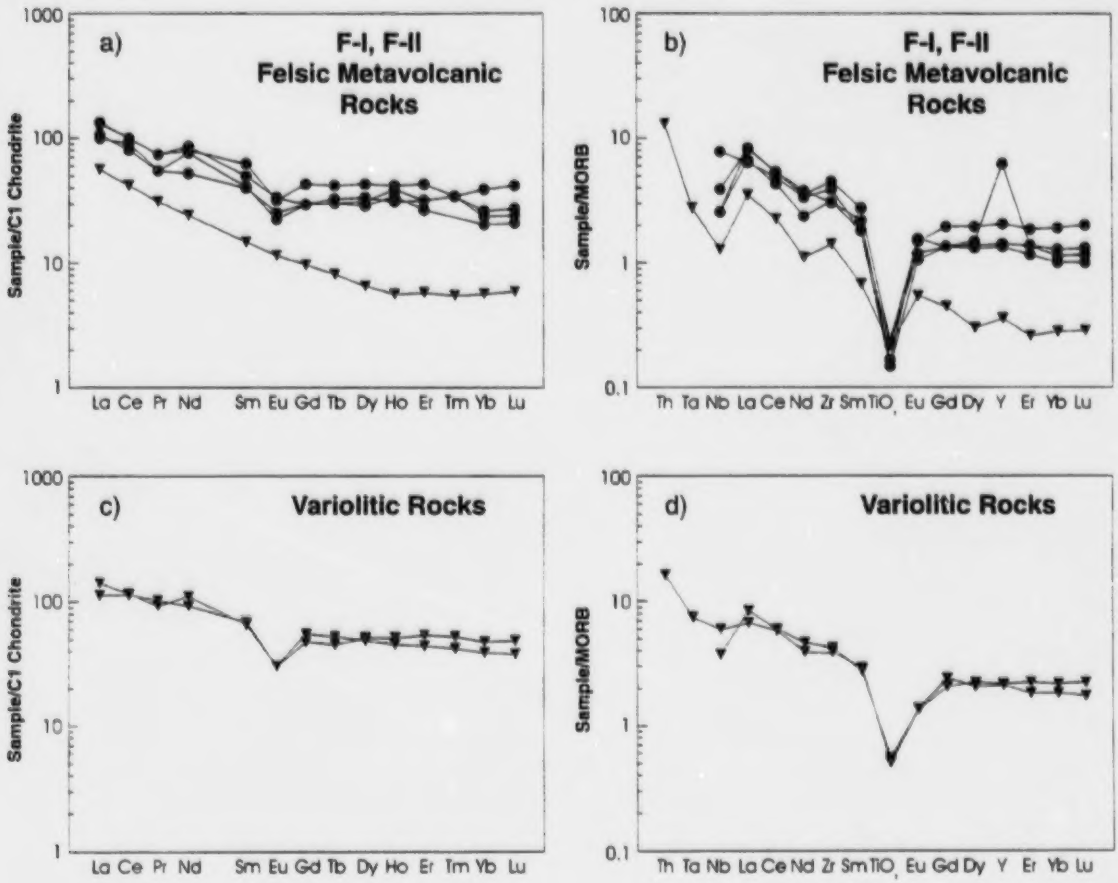
The third type of felsic metavolcanic rock in the Kidd–Munro assemblage is represented by a single sample and displays a strongly fractionated chondrite normalised REE pattern with no Eu anomaly (Figure 6a) similar to F-I felsic metavolcanic rocks (Lesher et al. 1986). A chondrite-normalised extended-element diagram displays strong niobium and HREE depletion and a positive europium anomaly (Figure 6b). This F-I rock occurs in the same area as the F-II felsic metavolcanic rocks east of the Black River.

Coalesced variolitic rocks commonly stratigraphically underlie the felsic metavolcanic rocks in Walker and western Wilkie townships. Major oxide geochemistry indicates that these rocks plot as tholeiitic and calc-alkalic andesite and dacite with moderately high TiO_2 and P_2O_5 (Figure 1b; Table 2). Rare-earth and extended-element diagrams display patterns interpreted by the author as representing a combination of F-II and F-III characteristics (Figures 6c, 6d) and are similar to "icelandite" at the Kidd Creek Mine (Heather et al. 1995). The author believes that these rocks are important to the petrogenesis of the felsic metavolcanic rocks in the Kidd–Munro assemblage and should be included in any discussion of felsic rock genesis.

Barrie et al. (1993) inferred that F-III felsic rocks at the Kidd Creek Mine were derived by partial melting of a tholeiitic substrate similar to felsic metavolcanic rocks at Kamiskotia. Barrie et al. (1993) also inferred that F-II and some of the F-III (F-IIIa, Lesher et al. 1996) were derived by partial melting of mixed tholeiitic and calc-alkalic precursors. F-I felsic rocks were derived from a garnetiferous source and underwent little high-level modification (Lesher et al. 1986). Felsic rocks in the Kidd–Munro assemblage are inferred to have been derived by similar processes; however, it appears that some mixing of F-III and F-II magmas must have occurred in order to derive the variolitic rocks which underlie the felsic rocks in Walker and Wilkie townships.

The geographic localisation of the F-II and F-I felsic rocks in the Kidd–Munro assemblage indicates that a local calc-alkalic substrate was partially melted if the model proposed by Barrie et al. (1993) is applicable. High precision U-Pb age dating could test for inherited zircons in the F-II rhyolites to investigate this theory. Further, it would appear that the mixing of F-III and F-II magma occurred in order to derive the coalesced variolitic rocks in the map area and this could be tested with detailed field and geochemical studies.

Figure 6 - Kidd-Munro assemblage; Trace Element Geochemistry



Dundonald Sill

The Dundonald Sill is a folded, layered, tholeiitic, mafic-ultramafic intrusion (Naldrett and Mason 1968; Green and MacEachern 1990). Readers are referred to these sources for more detailed descriptions of the rock types. Most of the sill underlies Dundonald Township, to the west of the map area; the author sampled only those parts of the sill in Clergue Township. REE and extended element diagrams display the same pattern but with different total REE abundances for each member of the sill and indicates fractionation occurred in a closed system from peridotite to pyroxenite and gabbro (Figure 7). The trace element patterns are similar to Type 1 basalts described above; however, whether the sill supplied magma for the basalts requires further field and geochemical testing.

BOWMAN ASSEMBLAGE

The Bowman assemblage contains sub-alkalic, magnesium- and iron-rich basalts, komatiitic metavolcanic and felsic intrusive rocks (Figures 8a, 8b; Table 3). Figure 8c shows that the mafic rocks in the Bowman assemblage are IAT-

like rocks, in contrast to the Kidd–Munro assemblage. Trace element data indicates that the mafic metavolcanic flows are N-MORB-like tholeiites that are less evolved than similar rocks in the Kidd–Munro assemblage (Figures 9a, 9b). The trace element data is unlike the Tisdale assemblage in the Timmins area and this indicates that the Bowman assemblage is unique to the Monteith area (Jackson and Fyon 1991; Berger 1999; Xie et al. 1993; Pyke 1982).

Ultramafic rocks are restricted to the Porcupine–Destor deformation zone in the map area and trace element geochemistry displays very erratic patterns that the author attributes to contamination and secondary alteration (Figures 9c, 9d; Table 3). The data does appear to be useful for petrogenesis and is presented without discussion.

Felsic intrusive rocks occur as dikes and sills in the Bowman assemblage; extrusive rocks were not mapped. A sodic albitite/trondjhemite dike from the Taylor gold deposit displays pronounced rare earth fractionation, Ta, Nb and extreme TiO_2 depletion (Figures 10a, 10b; Table 3) indicative of formation in an island arc environment (Syme et al. 1996). The albitite is interpreted to have an alkalic affinity and the trace element data supports this interpretation (King and Kerrich 1987).

A quartz-feldspar porphyry dike in southern Carr Township displays calc-alkalic geochemistry with less HREE fractionation than the albitite/trondjhemite dike (Figures 8b, 10a; Table 3). Depleted Ta and Nb, characteristic of an island arc tectonic setting are present (Figure 10b; Syme et al. 1996).

DUFF–COULSON–RAND ASSEMBLAGE

Major oxide geochemistry of the rocks in the Duff–Coulson–Rand assemblage indicates that they are calc-alkalic basalts, andesites and dacites (Figure 8b; Table 4). Mafic rocks are similar to IAT and contain relatively high potassium (Figure 8c; Table 4). Felsic metavolcanic rocks are all less than 70% SiO_2, with higher alumina and titanium than the Kidd–Munro assemblage.

Trace element geochemistry of the mafic metavolcanic rocks indicates that they are N-MORB tholeiites that contain slightly lower HREE than the Bowman assemblage and lower total REE than Type 1 Kidd–Munro basalts (Figure 11a). An extended-element diagram shows that Nb depletion is greater than Type 1 Kidd–Munro and Bowman assemblage basalts and contain higher Th than any of the Kidd–Munro and most of the Bowman assemblages (Figure 11b). Such patterns are most like island arc tholeiites (Swinden 1996).

Felsic Metavolcanic Rocks

All felsic metavolcanic rocks in the Duff–Coulson–Rand assemblage contain lower silica and higher alumina than the Kidd–Munro assemblage (Table 4). These rocks display fractionated REE patterns with elevated LREE between 50 and 100 times chondrite (Figures 10c, 10d). Pronounced negative Ta and Nb anomalies are compatible with derivation in an island arc tectonic setting (Figures 10c, 10d).

CARR TOWNSHIP QUARTZ-FELDSPAR PORPHYRY

The quartz-feldspar porphyritic intrusion in Carr and Taylor townships is calc-alkalic with sodium above 5% (Table 5). Rare-earth and extended-element diagrams display similar patterns to the Duff–Coulson–Rand felsic metavolcanic rocks indicating derivation in an island arc tectonic setting (Figures 10e, 10f). The geochemical similarity between these two rock suites does not imply that they are correlative, as the Duff–Coulson–Rand assemblage is 2713 Ma (Corfu et al. 1993) and the quartz-feldspar porphyry intrusion is less than 2699 Ma.

Figure 7 - Trace Element Geochemistry; Dundonald Sill

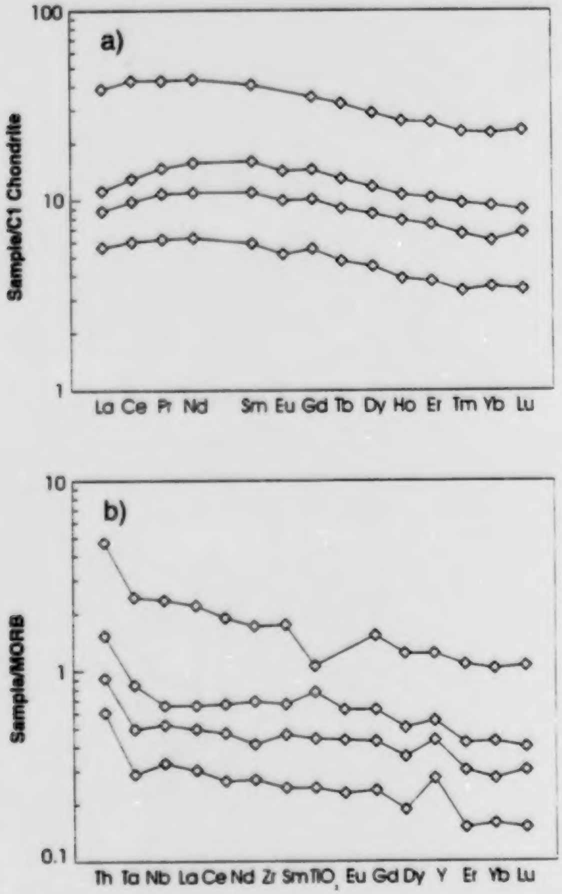
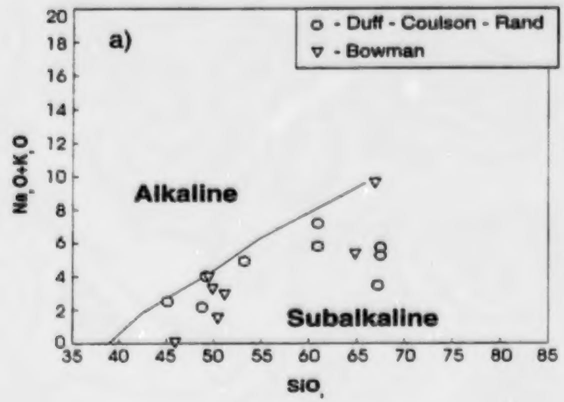
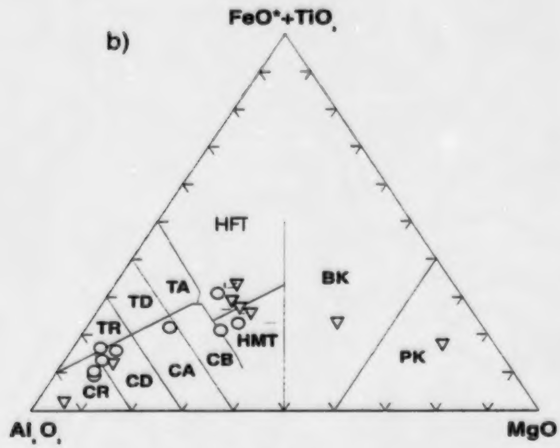


Figure 8 - Major Oxide Geochemistry; Bowman and Duff - Coulson - Rand assemblages





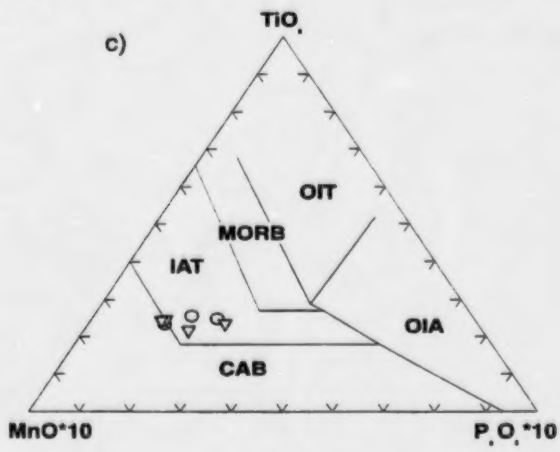


Figure 9 - Mafic and Ultramafic Rock Geochemistry; Bowman assemblage

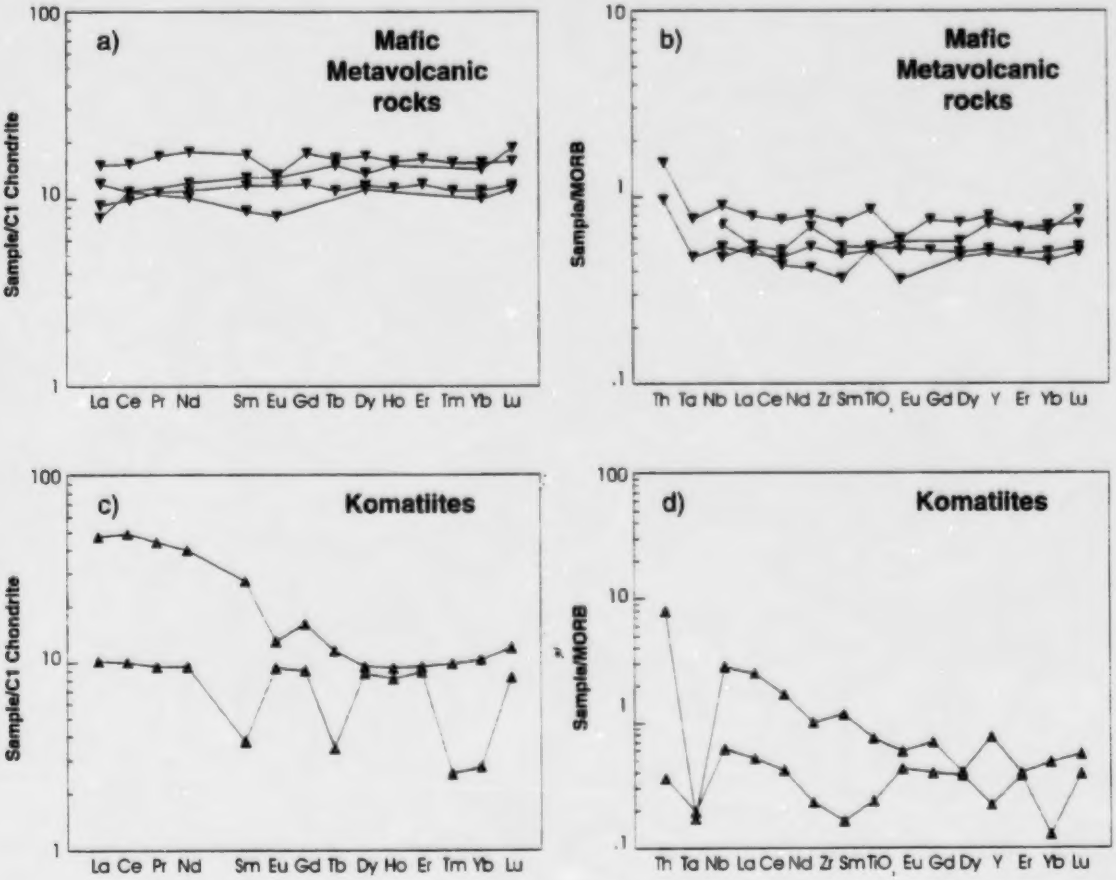


Figure 10 - Trace Element Geochemistry; Felsic Rocks - Monteith Area

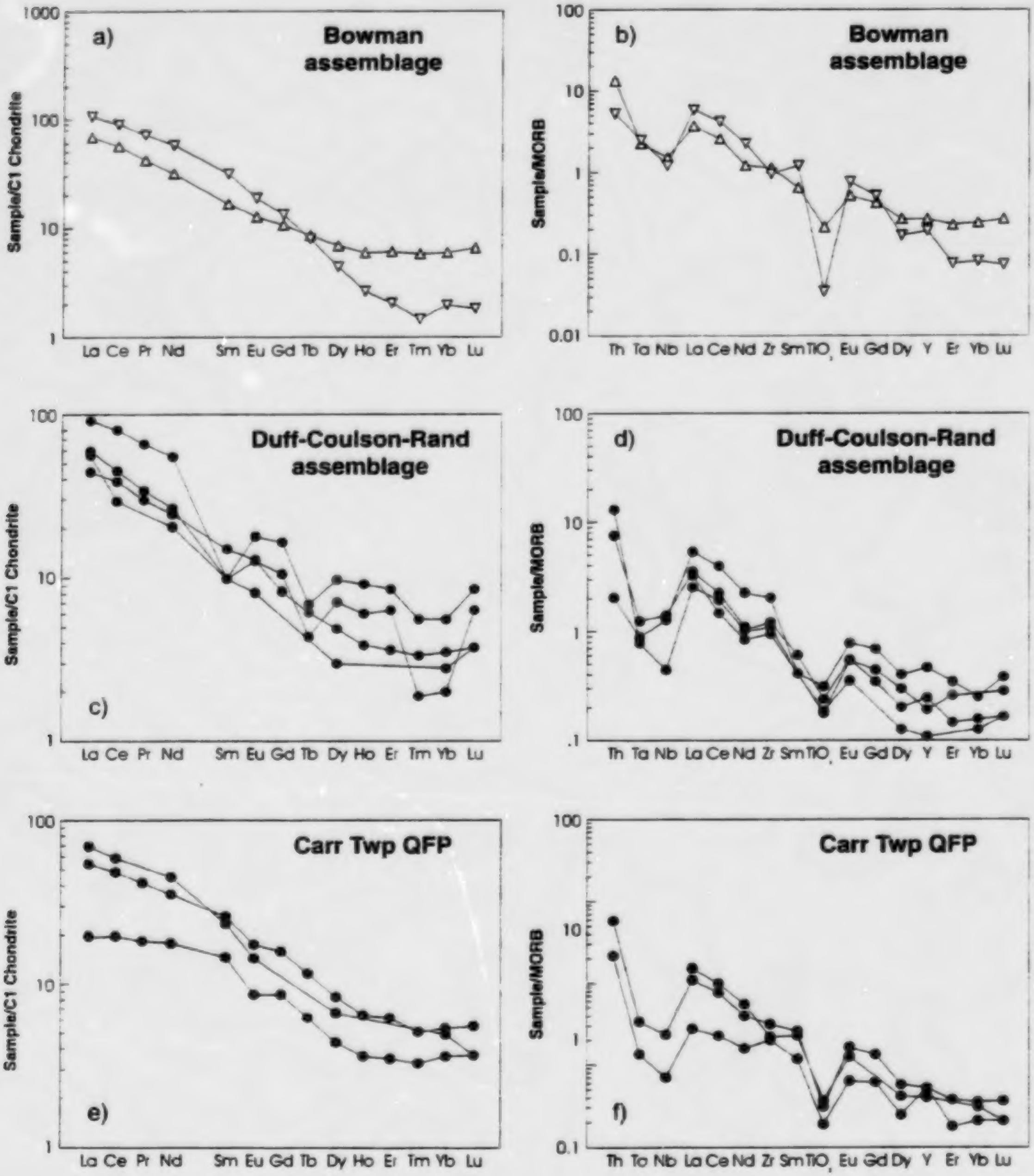
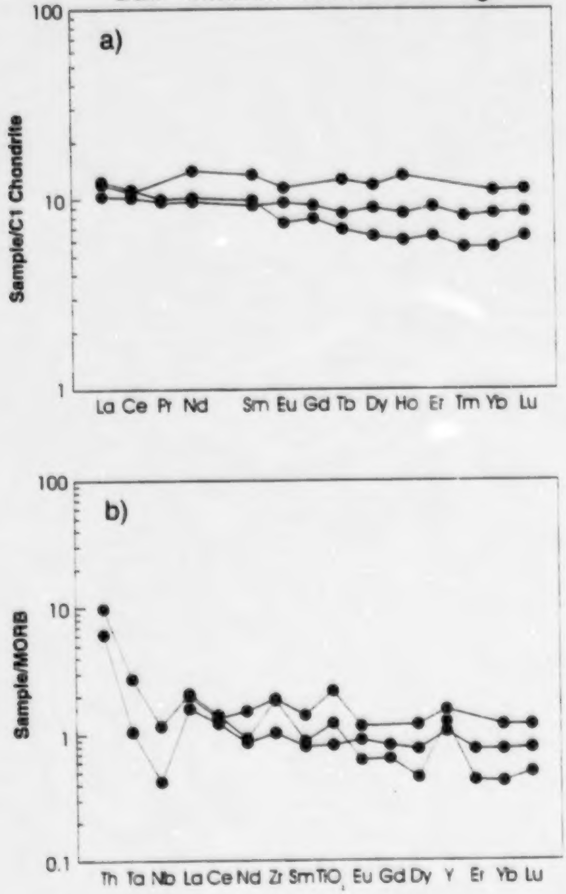


Figure 11 - Trace Element Geochemistry; Mafic Metavolcanic rocks - Duff - Coulson - Rand assemblage



Structure and Metamorphism

This chapter will describe the general structural and metamorphic features with emphasis on the regional deformation zones as inferred from geophysical data in the Monteith area. Outcrop in the Bowman and Kidd–Munro assemblages provides a basis for structural synthesis; however, details are lacking. In particular, the relationship of structure and gold mineralisation is known only in the large scale and the kinematics of the Pipestone fault and Porcupine–Destor deformation zone are unknown. Emphasis will be placed on the style of deformation within and the contact relationships among the various assemblages.

DUFF–COULSON–RAND ASSEMBLAGE

Very little is known about the structure of the Duff–Coulson–Rand assemblage because it is so poorly exposed. Outcrops on the Abitibi River in lots 6 and 8, Concession VI, Walker Township display a weakly developed east-northeasterly trending foliation. Drill core samples display a weak to strong foliation depending on location within the assemblage. Intermediate metavolcanic and metasedimentary rocks in the central part of the assemblage are weakly to moderately foliated whereas metasedimentary and felsic metavolcanic rocks are schistose near the inferred contact of the Duff–Coulson–Rand and Kidd–Munro assemblages. The intensity of development of the schistosity indicates that the contact is structurally modified and the author has inferred that a major easterly trending shear zone marks the contact between the two assemblages. A pronounced linear airborne magnetic high occurs immediately south of the inferred shear zone and serves to highlight the geophysical contrast between the lower magnetic susceptibility of the Duff–Coulson–Rand assemblage and the higher magnetic susceptibility of the Kidd–Munro assemblage.

A northwesterly striking foliation locally overprints a northeasterly striking foliation in the Duff–Coulson–Rand assemblage in Little Township, west of the map area (Berger 2000). Here the assemblage appears to be southwest younging based on only a few stratigraphic facings. Stratigraphic facings in Dundonald Township (Muir 1995a) and a stratigraphic facing from this study are south to southwest younging.

KIDD–MUNRO ASSEMBLAGE

Primary volcanological structures are well preserved in the Kidd–Munro assemblage and reversals in facings of pillow, flow-top breccia and felsic flow morphology indicate that the assemblage is folded about easterly to northeasterly trending axes. In most outcrops a single, weakly developed, layer-parallel foliation was observed; a few outcrops are massive and in a few outcrops near the Pipestone fault a northerly to north-northeasterly crenulation foliation was observed. In many outcrops a vertically to steep easterly dipping fracture foliation was observed which increased in intensity near Matachewan diabase dikes. This fracture foliation is common west of the map area where it is accompanied by north-trending brittle faulting (Berger 1992, 1994, 1999). Lineations are poorly developed in the map area and, where observed, are moderately westward plunging. West of the map area extensional and mineral lineations are easterly plunging and this indicates that the map area lies within a different structural domain than the Timmins or Kidd Creek Mine area (Berger 1992, 1994, 1999).

A number of north-northwesterly and northeasterly trending faults are inferred to cut the Kidd–Munro assemblage. The north-northwest-striking faults are commonly brittle and display vertical offsets. Intermediate metavolcanic rocks are terminated at one of these faults in western Clergue Township and a north-northwesterly fault is inferred to underlie the Black River in Carr Township. The northeasterly trending faults generally display complex dextral shearing and are most common near the Pipestone fault with which they may be related. Some of the northeast-striking faults occur near the inferred fold axes and it is possible that here the faults may represent thrust planes and the geology may be imbricated rather than folded.

HOYLE ASSEMBLAGE

Very little exposure was observed, consequently, very little is known about the structure of the Hoyle assemblage in the map area. Bedding is east-northeast- to west-northwest-striking and primary features such as grain gradation and load casts are poorly preserved. Prest (1951b) concluded that the metasedimentary rocks in Carr Township were north younging and underlay metavolcanic rocks of the Kidd–Munro assemblage. Johnstone (1991) indicated that the metasedimentary rocks were north facing in Beatty Township and were also older than the metavolcanic rocks. These conclusions are in conflict with recent U-Pb age of detrital zircons which indicate that the Hoyle assemblage is 2699 Ma, approximately 10 to 15 Ma younger than the Kidd–Munro assemblage (Bleeker et al. 1996). Berger (1992, 1994) indicated that facing reversals about east-west- and northeast-trending fold axes were common west of the map area. Until more diamond drill data is obtained from the map area, structural relationships in this part of the Hoyle assemblage will remain vague.

BOWMAN ASSEMBLAGE

Pillowed and massive mafic flows are well preserved and stratigraphic facings are generally southward younging. Flow contacts are oriented approximately 100° azimuth, whereas a penetrative foliation is generally oriented at 110° azimuth. Flows and foliation are shallow south dipping which the author has interpreted as an indication that the Bowman assemblage is thrust over the Hoyle assemblage to the north. Extensive diamond drill data at the Shoot Zone and Taylor gold deposits indicate that the Porcupine–Destor deformation zone dips southward at 45° supporting the thrusting concept (see below).

PORCUPINE–DESTOR DEFORMATION ZONE

The Porcupine–Destor deformation zone is an easterly striking regional structure which hosts major gold deposits at several locations. In the Monteith area the deformation zone marks the boundary between the Hoyle and Bowman assemblages and hosts three gold deposits in Taylor Township (Shoot Zone, West Porphyry and Porphyry zones). The structure, known only from diamond drill holes, is best described from the Shoot Zone gold deposit in lot 9, Concession II, Taylor Township (Worden et al. 1995; Shegelski 1989). In this area, the deformation zone is characterised by several discrete, shallowly southward-dipping fault surfaces which separate weakly deformed metasedimentary and metavolcanic rocks from intensely sheared ultramafic and mafic metavolcanic rocks. Quartz- and feldspar-porphyritic trondjhemite intrudes the deformation zone and is locally sheared suggesting that intrusion was, in part, synkinematic. Grain gradation, load casts, flaser bedding and spinifex textures are locally preserved, however their utility in establishing "stratigraphy" in the deformation zone is uncertain (Worden et al. 1995).

Interleaved metasedimentary and ultramafic metavolcanic rocks are separated by narrow zones of intense shearing in drill core in lots 4 and 5, Concession II, Taylor Township. Diamond drill logs described similar interleaving of mafic and ultramafic rocks from Carr Township and these observations support the conclusion that the Porcupine–Destor structure is a deformation zone up to 600 m wide with many structural complexities.

Airborne magnetic data indicate dextral offset and refraction of the olivine and Matachewan diabase dikes by the Porcupine–Destor deformation zone (OGS 1984d, 1984e). As these dikes are inferred to be younger than the deformation, the author believes the dikes exploited older fracture sets that were offset. Magnetic and diamond drill data indicate that the deformation zone dips moderately to the south in the Monteith area and in Stock Township to the west (Spector 1994). Siragusa (1993) inferred that the Porcupine–Destor deformation zone was a reverse or thrust fault in Taylor Township and data collected for this report supports this interpretation.

PIPESTONE FAULT

The Pipestone fault (Prest 1951b) is a regional-scale structure that marks the contact between the Kidd–Munro and Hoyle assemblages and is economically important as it serves as the locus for gold mineralisation. The fault is poorly exposed and little is known about its morphology and kinematics. Airborne magnetic data indicate that the olivine diabase dikes in Wilkie Township are dextrally refracted by the Pipestone fault (OGS 1984c). Prest (1951b) reported that "drag folds" indicated south-side-up movement on the Pipestone fault in Carr Township. Johnstone (1991) was unable to trace the Pipestone fault into Beatty Township; however, he referred to "the Contact fault" at the metasedimentary-metavolcanic rock interface as displaying dextral offset with steeply eastward-plunging lineations. The author infers that "the Contact fault" is the Pipestone fault. Siragusa (1993) concluded that easterly plunging, Z-type small-scale folds in the Montclerg gold deposit area indicated north-side-up vertical movement on the fault and these data conflict with Prest's observations. Further work is required to resolve these problems.

Malczak (1986) indicated that the Clavos gold deposit (approximately 6 km west of the map area) is within the Pipestone fault zone that is characterised by a discrete fault plane and fault gouge up to 4 m wide. Strongly foliated rocks, altered felsic dikes and interleaved metasedimentary and metavolcanic rocks occur over a width of at least 30 m suggesting that a deformation zone accompanies the fault. The Montclerg gold deposit in Clergue Township is hosted in sheared and hydrothermally altered felsic rocks that appear to be in an east-northeast-trending splay fault north of the Pipestone fault. Emens (1943) indicated that sheared rock south of the ore zone was up to 137 m (450 feet) wide and the author interprets this to be the Pipestone fault.

Trenches in lot 2, Concession VI, Carr Township host the Carlo gold showing which the author infers to be near the Pipestone fault. Mafic metavolcanic rocks in the trenches display a strong foliation at approximately 300° azimuth and a weakly developed crenulation cleavage at 200° azimuth. Pyritic quartz veins up to 1 m wide occupy the northwesterly foliation, whereas narrow, barren quartz veins occupy the crenulation cleavage. Well-developed shallow-plunging extensional and mineral lineations at 100° were observed on the northwesterly trending foliation planes and these data indicate south-side-up oblique dextral movement in accordance with previous observations in this part of the fault system.

Low-grade regional metamorphism has affected the entire map area and in many places rocks display primary mineralogy and textures. In ultramafic and mafic metavolcanic rocks typical metamorphic mineral assemblages are chlorite, epidote, talc and serpentine with or without white mica if plagioclase is present. Rarely, secondary amphibole (tremolite or actinolite) may be present if the parent rock is adjacent to one of the numerous diabase dikes. Calcite may occur in the mafic or ultramafic protolith if it is near one of the north or north-northwest brittle faults as these faults commonly contain calcite-healed fault gouge. Carbonate introduced into the protolith by hydrothermal alteration is common near the regional Pipestone fault and Porcupine–Destor deformation zone and in smaller shear zones throughout the map area. Much of this type of carbonate is iron rich and imparts a brown to orange-brown weathering rind to the protolith.

Intermediate and plagioclase-bearing mafic metavolcanic rocks are commonly very epidote rich. Very-fine-grained granular epidote comprises much of the mineralogy and has altered all but the plagioclase in these rock types. Consequently, these rock types are very light weathering and commonly appear to be more felsic than indicated by geochemistry. The plagioclase contains small amounts of epidote but is more commonly altered to microscopic white mica and consequently is also light coloured.

Felsic metavolcanic and intrusive rocks contain few minerals diagnostic of metamorphic grade; however, there are distinct mineralogical differences between felsic rocks of differing geochemistry. For instance, the high silica, F-III and F-II type rhyolites in the Kidd–Munro assemblage contain blue birefringent, iron-rich chlorite and fine-grained epidote throughout their groundmass or matrix. The calc-alkalic metavolcanic rocks in the Duff–Coulson–Rand assemblage and intrusive rocks in the Hoyle assemblage contain abundant white mica and green to beige chlorite; epidote is not as abundant as in the Kidd–Munro felsic metavolcanic rocks.

Pelitic metasedimentary rocks in the Hoyle assemblage contain white mica, chlorite, epidote and less commonly carbonate. As with other members of this assemblage west of the map area, biotite is absent and this indicates that metamorphism attained only lower greenschist facies (Winkler 1979).

Alteration

GOLD

Hydrothermal alteration is distinct from regional metamorphism and has affected rocks in several parts of the Monteith area. Alteration associated with gold mineralisation is restricted to the regional deformation zones and is characterised by ubiquitous pervasive carbonate that has affected all rock types. Hamilton et al. (1995) identified ankerite, dolomite, siderite, magnesite and calcite in decreasing order of abundance from rocks at the Shoot Zone gold deposit. Within this carbonate halo, moderate to intense sericite and albite alteration zones can be distinguished and these are commonly accompanied by more spatially restricted zones of pervasive and/or vein silicification. Hematite is erratically developed within the Porcupine–Destor deformation zone and the Pipestone fault and is more commonly reported to occur within or near felsic intrusions than in other rock types. Green mica alteration is abundant where ultramafic rocks have been hydrothermally altered, however, green mica "clasts" or narrow veinlets occur in other rock types which suggests that migration of hydrothermal fluids was common to the alteration systems. Other hydrothermally derived silicate minerals included tourmaline at the Montclerg deposit and in Wilkie Township, red apatite at the Porphyry Gold deposit and purple fluorite in sheared sericitized felsic metavolcanic rocks in northern Walker Township.

Pyrite is the most common sulphide mineral associated with the gold deposits and occurs at every deposit and showing. Arsenopyrite or geochemically elevated arsenic is common along the Pipestone fault and less common along the Porcupine–Destor deformation zone. Gold is preferentially associated with arsenopyrite at the Montclerg deposit. Chalcopyrite occurs in trace abundance at the Shoot Zone but appears to be preferentially associated with the better gold assays (Shegelski 1989). Gersdorffite, millerite and cobalt pentlandite were identified by scanning electron microscope electron dispersive spectrometry at the Shoot Zone (Hamilton et al. 1995). Graphitic carbon was observed at many of the gold occurrences in the map area, a feature which also is characteristic of gold mineralisation in Hoyle Township (Berger 1992). Carbon appears to have acted as a reductant at the Owl Creek mine and the deposition and localisation of gold mineralisation at this location is discussed by Wilson and Rucklidge (1987, 1986).

BASE METALS

Hydrothermal alteration associated with stringer and disseminated copper-zinc-lead mineralisation has affected approximately 6 km^2 of rock in southwestern Wilkie Township. Pervasive iron-rich chlorite has affected the metavolcanic stratigraphy and varies from weak to strong intensity. In the field, chloritised mafic metavolcanic rocks are dark green to black, very soft to flaky and densely matted in texture. Primary structures such as pillows and flow brecciation are well preserved, however, many outcrops display deep glacial gouging and well-developed striations. Chloritised felsic metavolcanic outcrops are grey to dark grey weathering or are grey in diamond drill core where they resemble intermediate metavolcanic rocks observed in other parts of the Abitibi greenstone belt (Berger 2000). Primary structures vary from well preserved to obliterated based on proximity to faults, original grain size and intensity of alteration. In thin section, blue birefringent chlorite most commonly occurs throughout the groundmass or matrix of the rocks and occurs less commonly in narrow stringers. In one sample chlorite has selectively replaced the glassy portions of a spherulitic rhyolite, however, delicate perlitic cracks and textures are well preserved (Photo 2). Chloritization is typical in the centre of hydrothermal alteration pipes and is common in base metal deposits of the Noranda type (Lydon 1988). Detailed morphological and geochemical studies were not made by the author; however, extensive exploration by industry has determined that there are many similarities between the alteration zone in Wilkie Township and other base-metal-bearing areas.

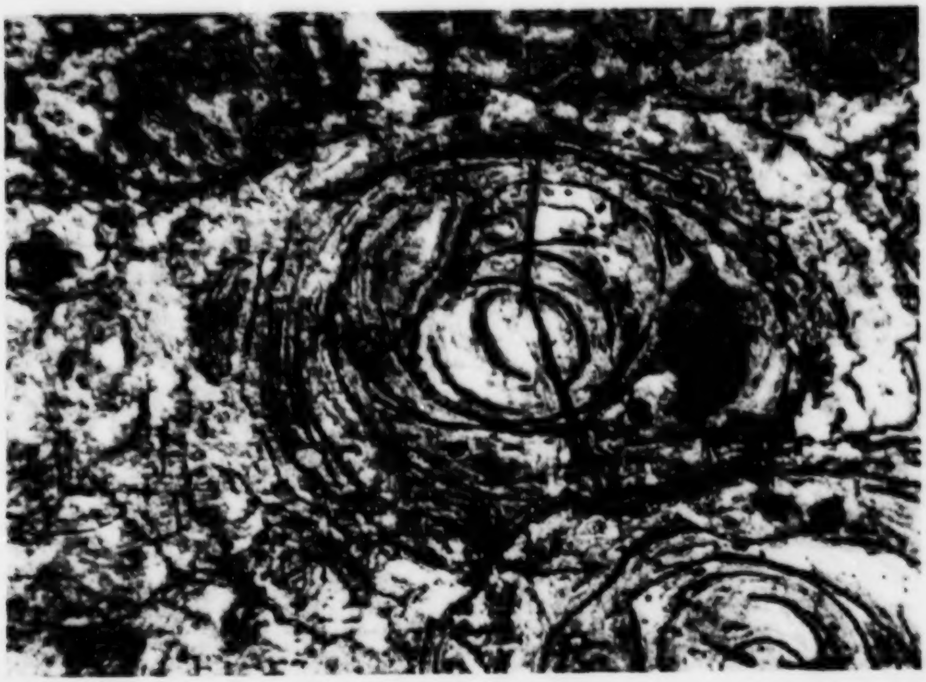


Photo 2. Perlitic cooling cracks in chloritized rhyolite from Wilkie Township (field of view is 8 mm).

Within the chloritised zone industry explorationists noted weakly developed pervasive vein silicification. Also, disseminated and vein copper-zinc-lead sulphide mineralisation was encountered in several diamond drill holes. The best mineralised section reported to date is 1.42% Cu and 1% Zn over 4.1 m in lot 10, Concession II, Wilkie Township by Noranda Exploration Company in 1962.

Quartz-feldspar porphyry intruded the Hoyle assemblage in Carr Township and an 11 km^2 stock was defined by geophysical and drill data by this survey. Diamond drill core examined by the author displayed wide intervals of intense white mica alteration accompanied by zones of weak to intense hematization and silicification. Stringers of pyrite and chalcopyrite were common and auriferous quartz veins were encountered near the northern contact of the intrusion. Disseminated molybdenite and native copper were reported in diamond drill logs. Whole rock geochemistry indicates that the porphyry is calc-alkalic with strong sodium enrichment (6 to 8% Na_2O). Much more exploration and study is required to adequately define the style and types of alteration and mineralisation, however, the mineralisation exhibits some similarities to porphyry copper intrusions (McMillan and Panteleyev 1988).

Economic Geology

Four gold deposits occur in the Monteith area. The Montclerg Deposit in Clergue Township is associated with the Pipestone fault and the Shoot Zone, West Porphyry and Porphyry zones are associated with the Porcupine–Destor deformation zone in Taylor Township. Several other gold occurrences associated with these two regional structures are reported from Carr and Wilkie townships. Base metal mineralisation occurs in Wilkie and Walker townships. Nickel-copper mineralisation was mined just west of Clergue Township at the Alexo deposit. Porphyry-style copper and molybdenum and quartz-vein-hosted gold occurs in altered calc-alkalic quartz-feldspar porphyry that intruded

the Hoyle assemblage in central Carr Township. Table 6 (*see* "Appendix 2") summarises the work filed for assessment credits and Bath (1990) provides additional information for exploration in the map area. This chapter will emphasise the major mineralised environments and present recommendations for future exploration.

NICKEL-COPPER

The Alexo deposit which produced 56 780 tons of ore at 3.94% Ni and 0.71% Cu is approximately 80 m west of Clergue Township in Dundonald Township (Bath 1990). Massive and net-textured pentlandite, pyrrhotite and chalcopyrite were mined from a footwall embayment in komatiites in contact with massive and pillowed intermediate metavolcanic rocks (Green and MacEachern 1990). The komatiitic rocks extend into Clergue Township where they are intruded by ultramafic and mafic units of the Dundonald Sill (Green and MacEachern 1990) and are folded about northeast-striking axes.

Exploration by Falconbridge Nickel Mines Limited and Canadian Nickel Company Limited (INCO) in the west-central part of Clergue Township has concentrated on diamond drill testing geophysical targets spatially associated with the ultramafic rocks. Results from one INCO drill hole included 0.8% Cu over 2.3 m in dacite breccia and 0.46% Cu, 0.32% Ni and 1.15% Zn over 3.7 m in serpentinite (lot 10, Concession III). Drill holes along strike did not encounter additional mineralisation and this was interpreted at the time to indicate that the sulphide lens was isolated. Most of the other drill holes in the vicinity either failed to reach bedrock or did not adequately explain the target geophysical conductor.

Exploration by Selco Incorporated, Dominion Gulf Company and Hollinger Consolidated Gold Mines Limited in southwestern Clergue Township encountered asbestos, magnetite and chromite mineralisation in the ultramafic portions of the Dundonald Sill but sulphide mineralisation was not reported. Mafic, intermediate and felsic metavolcanic rocks were reported in the drill holes; however, drill logs did not indicate any obvious cause for the electromagnetic conductors in this area.

Komatiite-hosted nickel mineralisation is reported to occur in several places in Dundonald Township to the west (Green and MacEachern 1990) and there is good potential for the same type of mineralisation as the favourable stratigraphy extends into Clergue Township. There remain a number of untested airborne electromagnetic conductors throughout the western part of Clergue Township (OGS 1984a) and much of the previous work appears to have not adequately explained the electromagnetic conductors. In particular, the Cu-Ni-Zn mineralisation in lot 10, Concession III should be re-evaluated and airborne EM anomalies to the southwest should be tested (OGS 1984a). There is no report of testing of the ultramafic-intermediate metavolcanic rock contact in the map area although there are electromagnetic conductors indicated (OGS 1984a).

Ultramafic rocks form narrow mappable units in several parts of the Monteith area with the thickest of these units in central Wilkie Township. There has been relatively little exploration for komatiite-hosted nickel although airborne EM anomalies are associated with several of the ultramafic units. Anomalies in lots 2 to 8, Concession III, Wilkie Township appear to have the most potential for copper-nickel mineralisation as they are associated with the thickest accumulations of komatiite.

BASE METALS

There are no known base metal deposits in the map area; however, exploration has identified several mineralised occurrences, and hydrothermal alteration commonly associated with volcanogenic massive sulphide deposits occurs in southwestern Wilkie Township.

Kidd–Munro Assemblage

Exploration by various companies has identified hydrothermally altered felsic and mafic metavolcanic rocks containing stringer chalcopyrite, sphalerite and galena in southwestern Wilkie and southeastern Walker townships. The alteration covers an area approximately 6 km by 1.5 km and is characterised by intense pervasive iron chloritization, various amounts of alkali depletion, sericitization, carbonatization and silicification of the metavolcanic stratigraphy. Trace element geochemistry indicates that two types of felsic metavolcanic rocks with REE patterns similar to F-II and F-III rhyolites (Lesher et al. 1986) occur in this part of the map area. Both types of rhyolite are spatially associated with volcanogenic massive sulphide deposits in other parts of the Abitibi Subprovince (Lesher et al. 1986; Barrie et al. 1993). Lydon (1988) indicated that the inner zone of some massive sulphide alteration systems in the Noranda area is similar to that in the Monteith area which indicates that continued exploration may discover massive sulphide mineralisation. Reported base metal assays include 1.44% Cu over 4.6 m in lot 10, Concession II, Wilkie Township, and 0.3% Cu and 0.5% Zn over 0.1 m in lot 1, Concession II, Walker Township. Assays as high as 9% Zn and 1% Pb over narrow intervals are common within the felsic metavolcanic rocks in Wilkie Township (J. Pattison, Falconbridge Limited, personal communication, 1996). The author has inferred that felsic metavolcanic rocks occur north of the most intensely explored area in Wilkie Township. There are few airborne electromagnetic conductors indicated; nevertheless, exploration in lots 10 to 12, Concession IV, Wilkie Township and lots 1 and 2, Concession IV, Walker Township is recommended to test for the presence of felsic rocks and the potential for deep-seated base metal mineralisation.

In lot 4, Concession I, Wilkie Township, trenching by N. McChristie in 1983 exposed copper-zinc-gold mineralisation in sheared felsic and mafic metavolcanic schist. Samples of selected high-grade mineralisation collected by the author returned up to 1.55% Cu, 0.29% Zn and 715 ppb Au over 0.5 m (analysis completed by Geoscience Laboratory, Ontario Geological Survey, Sudbury). Exploration by Falconbridge Limited did not establish any continuity to this mineralisation and no further work was reported. Massive rhyolite exposed 200 m north of the mineralisation and equigranular tonalite 500 m south of the trench contain trace and REE element patterns similar to F-II and F-III rhyolites (Lesher et al. 1986; samples 96-482, 96-494 in Table 2, *see* "Appendix 1"). The tonalite is part of a more extensive pluton that the author has interpreted to represent a subvolcanic intrusion and possible magma source for some of the felsic metavolcanic rocks in the Kidd–Munro assemblage. Any electromagnetic conductor spatially associated with this intrusion warrants examination.

Felsic metavolcanic rocks in lot 7, Concession II, Walker Township are identified in this report as F-III rhyolites contiguous with the felsic metavolcanic rocks in Wilkie Township. Although these rocks display only weak silicification, there a number of untested electromagnetic conductors along strike to the east (OGS 1984b). The most interesting are those conductors in lots 2, 3 and 4, Concession II, Walker Township, in the author's opinion. Outcrops along the Black River in lot 3 are silicified variolitic flows mixed with massive dacite and lie stratigraphically below the inferred position of the felsic metavolcanic rocks and associated conductors. Geochemistry of the variolitic flows shows that these rocks contain high silica, titanium and phosphate, and REE patterns that display some similarity to icelandite, a rock type found in the Kidd Creek Mine area (Barrie et al. 1993). Exploration in this part of the map area is strongly recommended.

Narrow F-III rhyolite units and geochemically similar quartz-feldspar porphyry occurs in the southern part of Clergue Township and at the Montclerg gold deposit. These felsic units are weakly silicified and potassium enriched in at least one place in lot 6, Concession I (*see* "Geochemistry"). Massive and disseminated pyrite ± graphite occurs in amygdaloidal mafic flows stratigraphically below the felsic rocks. Results from previous exploration in lots 5 and 6, Concession I were largely negative and indicate that the geology is more complicated than portrayed on Map P.3367 (back pocket). There are several narrow felsic flows in this area that form wedges and lenses interlayered with mafic units and the search for felsic rocks and associated base metals in the subsurface will prove most difficult. A number of airborne electromagnetic conductors in lots 8 and 9, Concession I (OGS 1984a) may represent the westward extension of the pyritic and graphitic horizon, and felsic metavolcanic units in lot 12, Concession I may also warrant base metal exploration.

Quartz-phyric felsic rocks similar in morphology to those in central Walker Township occur in lots 9 and 10, Concession II of Clergue Township. Limited exploration in this area indicates that the felsic rocks are not extensive but based on similar morphology to known F-III rhyolites and their association with electromagnetic conductors, continued exploration is warranted.

Duff–Coulson–Rand Assemblage

Copper and zinc mineralisation is reported to occur in hematized "andesite" and graphitic felsic schist from lot 3, Concession V, Walker Township. Up to 4400 ppm Cu over 0.6 m and 1700 ppm Zn over 3 m occurs as disseminated and vein sulphides. Exploration along strike to the east encountered massive and disseminated pyrite with minor base metal values (0.15% Cu, 0.17% Zn, 1.37 g/t Au and 4.39 g/t Ag over narrow intervals) in felsic tuff, epiclastic rocks and wacke. Geochemistry of the felsic rocks indicates that they are calc-alkalic and similar to F-I felsic rocks defined by Lesher et al. (1986). Such geochemistry is not conducive to base metal mineralisation, however, there remain several untested airborne electromagnetic conductors in the map area (OGS 1984b, 1984c).

Hoyle Assemblage

Disseminated copper, molybdenum and gold mineralisation was discovered by Canamax Resources Limited in lot 7, Concession V, Carr Township in 1983 as part of a regional program to test airborne geophysical conductors. The mineralisation is hosted in a calc-alkalic quartz-feldspar porphyry pluton that intruded clastic metasedimentary rocks of the Hoyle assemblage. The pluton, characterised by higher magnetic susceptibility than the surrounding metasedimentary rocks, is inferred to cover approximately 16 km^2 and has two apophyses to the west in Taylor Township. Exploration work by Falconbridge Limited and later by Pentland Firth Ventures Limited to test IP and resistivity geophysical targets encountered several mineralised zones, the best of which assayed 0.35% Cu over 30 m and 1030 g/t Au over 0.3 m. The mineralisation occurs as disseminations, vein sulphides and quartz veining and is accompanied by various amounts of white mica alteration, hematization and silicification. Where localised shear zones occur, the porphyry is more intensely bleached, suggesting a structural control to some of the alteration. Geologists with Pentland Firth Ventures Limited believe that some of these structures are east-northeast striking, parallel to one of the regional trends in the map area (personal communication, G. Yule, Pentland Firth Ventures Limited, 1996). The alteration and style of mineralisation display some similarities to Phanerozoic porphyry copper deposits (McMillan and Panteleyev 1988).

The only portion of the pluton that has been explored shows that most of the higher-grade mineralisation is located near the northern contact between the porphyry and the metasedimentary rocks. However, mineralisation also occurs within the pluton and there remains much untested potential for porphyry-style copper-molybdenum mineralisation in the map area. None of the southern contact and none of the other porphyry bodies in Taylor Township have been explored. This style of mineralisation has the potential to yield low-grade, high-tonnage deposits and their occurrence is not well documented in the Abitibi Subprovince. Further exploration for this type of mineralisation is strongly recommended.

GOLD

The Montclerg deposit is located in Clergue Township and appears to be associated with a northeast-striking fault related to the Pipestone fault. The Shoot Zone, West Porphyry and Porphyry deposits are located within the Porcupine–Destor deformation zone in Taylor Township. Several additional gold occurrences are associated with the Pipestone fault and Porcupine–Destor deformation zone and favourable geological conditions for gold mineralisation were identified within shear zones in the northern part of Walker and Wilkie townships. Gold also occurs within quartz- and sulphide-bearing veins within a calc-alkalic quartz-feldspar porphyry intrusion in Carr Township.

Pipestone Fault

MONTCLERG DEPOSIT

The Montclerg deposit is reported to contain 371 008 tons at 0.132 ounce gold per ton (Canadian Mines Handbook, 1994-95) and was discovered after a landslide exposed auriferous felsic rocks on the Driftwood River in lot 1, Concession I, Clergue Township, in 1938. Readers are referred to Bath (1990) for details on the history of exploration. An east-northeast-striking alteration zone approximately 1300 m by 130 m was defined by diamond drilling in the 1940s and was inferred to be subparallel to the regional Pipestone fault (Bath 1990; Emens 1939). Gold mineralisation occurred throughout this alteration zone, however, the "more interesting" gold assays were associated with arsenopyrite and less commonly pyrite in and along the north contact between quartz-feldspar porphyry and mafic metavolcanic rocks only west of the Driftwood River (Emens 1939). The felsic porphyry was reported by Emens (1939) to be intrusive, however, Malczak (1986) and Bath (1990) reported pyroclastic textures were present in outcrop on the Driftwood River. Exploration in 1986 east of the Driftwood River encountered felsic porphyritic rock north of the previous drilling, however, it was sheared, silicified, carbonatized and sericitized such that its origin is doubtful. This rock examined in diamond drill core by the author is geochemically similar to F-III felsic extrusive and intrusive rocks in Wilkie and Clergue townships which indicates it is probably related to the volcanic stratigraphy rather than belonging to a separate, later intrusive event. Gold associated with arsenopyrite and pyrite also occurs within this felsic rock which suggests to the author that the gold mineralisation and felsic porphyry strike more northeasterly than the drill-defined alteration zone. It is likely that the Montclerg deposit is associated with a northeast-striking fault rather than the Pipestone fault as previously believed (Emens 1939; Malczak 1986). Several northeast-striking faults are geophysically inferred in this part of Clergue Township (*see* Map P.3367, back pocket) and it is recommended that future exploration attempt to locate and test these structures for their gold potential. Further, as the felsic rock is geochemically similar to F-III felsic metavolcanic rocks that are associated with volcanogenic base metal deposits, any airborne electromagnetic conductors in this part of the map area should be explored for their base metal potential.

WILCARR MINES LIMITED

Wilcarr Mines Limited carried out exploration along the Pipestone fault in lots 1 to 8, Concession I, Wilkie Township and lots 1 to 4, Concession VI, Carr Township in 1944 (Prest 1951b; Bath 1990). Gold-bearing quartz veins in a variety of rock types and alteration styles were encountered within the Pipestone fault (Bath 1990). Quartz veins at the Carlo Showing in lot 2, Concession VI, Carr Township are associated with carbonate, pyrite, arsenopyrite and chalcopyrite and are hosted in sheared and carbonatized mafic metavolcanic rocks of the Kidd–Munro assemblage. Bath (1990) reported assays up to 349 ppb gold and 9950 ppm arsenic from a grab sample in the trench and assays up to 2.43 ounces gold per ton are reported from the 1930s. Wilcarr Mines Limited did not encounter significant gold mineralisation in diamond drill holes in this area.

Gold-bearing quartz-carbonate-pyrite-galena veins are reported to occur in carbonatized and sericitized metasedimentary rocks of the Hoyle assemblage. Gold assays up to 0.16 ounce gold per ton were reported by Wilcarr Mines Limited, however the veins proved to be erratic in distribution. Maude Lake Gold Mines Limited explored for these types of veins without success in 1986. Gold was also reported to occur within quartz-carbonate-arsenopyrite stringers within narrow shear zones within the tonalitic subvolcanic intrusion in lot 7, Concession I, Wilkie Township. The best assay from this material returned 0.1 ounce gold per ton over 1.1 m but again the veins proved to be erratic in distribution (Bath 1990). No recent exploration is reported in this area.

The Pipestone fault is inferred to strike southeasterly with oblique south-side-up dextral movement on this part of the fault. It is possible that most of the stress was compressional and the rocks were not amenable to brittle failure in this area; that is important for the localisation of gold mineralisation (Colvine et al. 1986). Gold mineralisation may be more likely to occur where the fault becomes easterly or northeasterly striking. Additionally, vertical movement on the fault may generate flat-lying tensional veins or quartz stockworks and this possibility has not been tested.

Porcupine–Destor Deformation Zone

SHOOT ZONE

The Shoot Zone is located in lot 9, Concession II, Taylor Township and is reported to host 1 150 000 tons grading 0.157 ounce gold per ton to the 305 m level (St Andrew Goldfields Limited, press release, November 1996). The deposit is hosted in a narrow metasedimentary wedge in contact with ultramafic schist and feldspar-porphyritic tonalite (albitite) within the Porcupine–Destor deformation zone. Gold mineralisation was discovered in 1938 by Hollinger Consolidated Mines Limited as part of a regional exploration program along the Porcupine–Destor deformation zone and the Pipestone fault. Subsequent work by Esso Minerals Canada led to definition of the tonnage and grade reported above. The Ontario Geological Survey carried out field work in 1994 and 1995 as part of a multi-media geochemical sampling program in areas of thick overburden (Hamilton et al. 1995).

The Shoot Zone is known only from diamond drill core and its geology was summarised most recently by Worden et al. (1995). Gold mineralisation is contained within an easterly striking, southerly dipping clastic metasedimentary wedge enclosed by carbonatized ultramafic schist and occurs entirely within the Porcupine–Destor deformation zone (Worden et al. 1995). Mafic and intermediate metavolcanic rocks correlated by the author with the Bowman assemblage and intruded by tonalitic feldspar ± quartz porphyry dikes, sills and small stocks form the structural hanging wall. Clastic metasedimentary rocks correlated by the author with the Hoyle assemblage are in fault contact with the ultramafic schist and form the structural footwall to the ore zone. Gold occurs as discrete grains and less commonly with finely disseminated pyrite; chalcopyrite, pyrrhotite, cobaltite, gersdorffite and millerite have been reported (Worden et al. 1995; Hamilton et al. 1995). Carbonate and sericite alteration is most pronounced and thin sections from the immediate vicinity of the Shoot Zone indicate that quartz veining and pervasive silicification are common. The clastic metasedimentary rocks are predominantly fine-grained wacke and graphitic argillite that is variously carbonatized, sericitized and silicified (Worden et al. 1995). Talc, five species of carbonate, sericite and green mica are common alteration minerals in the ultramafic rocks (Hamilton et al. 1995).

The Shoot Zone is hosted mostly in metasedimentary rocks, unlike most other gold deposits in the map area. Shegelski (1989) indicated that the metasedimentary rocks were likely shallow-water deposits, in which case they would be similar to the Timiskaming-like Three Nations assemblage. These metasedimentary rocks are interpreted by the author to have been faulted into their present position based on their discontinuous, wedge-shaped geometry and that their contacts with the ultramafic rocks are sheared. The author observed that several narrow graphitic argillite and wacke units are tectonically interleaved with ultramafic rocks in drill core in lots 4 and 5, Concession III, Taylor Township and this style of deformation and geology is prevalent along this portion of the Porcupine–Destor deformation zone. Worden et al. (1995) and Shegelski (1989) indicated that the spatial association of gold mineralisation and felsic porphyries was an important consideration for exploration and this observation appears to be relevant in the map area.

The Shoot Zone was discovered as a result of systematic diamond drilling along the Porcupine–Destor deformation zone at a time when geophysical and other such indirect exploration methods were poorly developed. Multi-media geochemical exploration of the overburden appears to have successfully detected the ore zone and this technique holds promise for future exploration in the map area (Bajc 1996; Hamilton et al. 1995). The author is aware that St Andrew Goldfields Limited carried out induced polarisation surveys over the Shoot Zone property in 1996 in an effort to locate exploration targets; however, results of the surveys are unknown.

PORPHYRY AND WEST PORPHYRY ZONES

The Porphyry and West Porphyry zones underlie parts of lots 6 and 7, Concessions II and III in Taylor Township, approximately 2.5 km east of the Shoot Zone. Both porphyry zones are hosted within the Porcupine–Destor deformation zone and were discovered by Hollinger Consolidated Gold Mines Limited at approximately the same time and in the same manner as the Shoot Zone. The history of exploration is summarised by Bath (1990). The

Porphyry Zone contains 792 680 tons at 0.144 ounce gold per ton (Canadian Mines Handbook, 1996-97) and the West Porphyry Zone contains 1 300 000 tons at 9.6 grams gold per ton (Northern Miner, February 3, 1997).

The Porphyry Zone is located in lot 6, Concession III, Taylor Township and has been explored by surface and underground diamond drilling. Bulk samples and minor amounts of ore have been extracted from a shaft and limited underground drifting (Bath 1990). Gold mineralisation is hosted in iron-rich tholeiitic mafic and ultramafic metavolcanic rocks that were carbonatized, silicified and intruded by trondjhemite (Worden et al. 1995). Molybdenum and graphite mineralisation occur in a separate zone south of the ore body in association with trondjhemite and a discrete fault within the Porcupine–Destor deformation zone. A simplified cross section, in the assessment files at Kirkland Lake, portray several subhorizontal quartz vein zones developed at various depths within a wide zone of carbonatized mafic rocks. It is possible that the vein zones represent horizontal tension gashes that would support the idea that movement on the Porcupine–Destor deformation zone was largely vertical in this part of the deformation system. Consequently one might expect to discover more subhorizontal vein zones in stacked, *en échelon* geometry within the Porcupine–Destor deformation zone. Narrow, southerly dipping, auriferous quartz veins may be expected within the central part and within discrete faults or shear zones within the deformation zone.

Sheeted trondjhemite dikes display various amounts of muscovite, pyrite and phosphate enrichment with fluorapatite-bearing trondjhemite spatially associated with the footwall of the mineralised zone. Abraded zircon cores from the trondhjemite are approximately 2697 Ma; however, bulk zircon analysis yielded a U-Pb age of 2682 Ma which was inferred to be close to the peak of syntectonic activity in the area (Worden et al. 1995). Whole rock geochemistry supports previous data that the trondjhemite is enriched in sodium and aluminum over "normal" tonalite/trondjhemite (King and Kerrich 1987). Enrichment in the trondjhemite of P, F, REE, Zr, Hf, Th and U was inferred to have resulted from metasomatism similar to fenitization associated with alkaline intrusions (King and Kerrich 1987). These data suggest that the geological model explaining gold deposits as spatially associated with syenitic intrusions in the Abitibi Subprovince presented by Robert (1997) may be applicable to the Porphyry Zone.

The West Porphyry Zone is approximately 1 km east of the Shoot Zone and 300 m southwest of the Porphyry Zone. Gold mineralisation is hosted in flat-lying quartz stockworks within a "green carbonate" zone 427 m below surface (Northern Miner, February 3, 1997). The deposit is inferred by St Andrew Goldfields personnel to be south of the "Porcupine–Destor Fault" (*sic*) (Northern Miner, Feb. 3, 1997); however, the presence of green carbonate suggests to the author that alteration and deformation at the deposit are part of a larger zone associated with the Porcupine–Destor structure.

The style of mineralization consisting of flat-lying quartz stockworks is similar to that at the Porphyry Zone and similarly the author infers that they are tensional features in a vertical deformation zone. There is potential for additional stacked stockworks at depth to the south and at shallower depths to the north of the West Porphyry Zone.

GOLDEX RESOURCES INCORPORATED (N.A. TIMMINS)

Goldex Resources Incorporated explored part of the Porcupine--Destor deformation zone immediately east of the Porphyry Zone gold deposit in 1986. Previous exploration by N.A. Timmins Explorations (Ontario) Limited encountered up to 0.1 ounce gold per ton over 0.3 m in 1946 (Bath 1990). Goldex reported gold assays up to 0.357 ounce gold per ton over 0.25 m in diamond drill holes, however the continuity of the mineralisation could not be established and no further work was carried out. This part of the Porcupine–Destor deformation zone is characterised by easterly striking, southerly dipping, structurally interleaved units of ultramafic schist, graphitic argillite and siltstone, and sheared mafic metavolcanic rocks. Pervasive carbonatization, silicification and sericitization have affected these rock types to various degrees with the most intense alteration coincident with the ultramafic rocks. A few narrow, white, tonalite-albitite dikes were encountered in some of the diamond drill holes, however, the extent and volume of these dikes are small when compared to the Porphyry and West Porphyry zones.

JEFFRIS SHOWING

Very little has been reported about the Jeffris gold showing in lot 12, Concession III, Carr Township because the land is patented. Files in the Kirkland Lake Resident Geologist's Office indicate that diamond drilling was carried out by Hollinger Consolidated Gold Mines Limited sometime in the 1930s. Gold assays up to 0.63 ounce gold per ton are recorded in the files, however intersection widths, host rock and geological setting are not reported. Bath (1990) was unable to locate reported trenches and very little detail is known of the area.

The author infers that the Jeffris showing is located within mafic metavolcanic rocks of the Bowman assemblage and occurs within the Porcupine–Destor deformation zone. The style of gold mineralisation is likely similar to that elsewhere in the map area along the deformation zone and as such is a good target for future exploration efforts.

G.E. PARSONS

Exploration in lots 1 to 5, Concession II, Carr Township has discovered erratic gold mineralisation hosted in sheared metavolcanic rocks within the Porcupine–Destor deformation zone. A diamond drill hole sunk by G.E. Parsons in lot 4, Concession II encountered 4.66 ounces gold per ton over 0.6 m in chlorite-carbonate-talc schist and several other nearby drill holes encountered gold assays from 0.002 to 0.018 ounce gold per ton over narrow widths.

The gold mineralisation is accompanied by various amounts of carbonatization, silicification, pyrite and chalcopyrite. Specular hematite is reported in a few of the drill logs and green mica is common in sheared ultramafic rocks. Mafic metavolcanic rocks of the Bowman assemblage comprise the structural hangingwall and clastic metasedimentary rocks of the Hoyle assemblage comprise the footwall. Ultramafic rocks occur only within the Porcupine–Destor deformation zone and are most common in proximity to the contact with the Hoyle assemblage. The Porcupine–Destor deformation zone, commonly over 30 m wide, is developed mainly in the metavolcanic rocks at or near the contact with the Hoyle assemblage. The deformation zone dips at approximately 45° to the south and is characterised by widespread shearing and hydrothermal alteration in which several discrete fault planes are developed. Dioritic and locally "syenitic" dikes are reported in the drill logs, however these intrusions occur in neither the volume nor the same compositional range as observed at the Shoot Zone or Porphyry Zone farther west along the deformation zone.

The contact between the Duff–Coulson–Rand and Kidd–Munro assemblages is a shear zone which appears to be regional in scale and may join with the north branch of the Porcupine–Destor deformation zone east of the map area (Jensen and Langford 1985). Felsic schist in northern Walker and Wilkie townships is carbonatized, sericitized, locally silicified and pyritic. A gold assay from felsic schist in the shear zone returned 5500 ppb Au over 0.25 m from lot 12, Concession IV, Wilkie Township (J. Pattison, Falconbridge Limited, Timmins, personal communication, 1996). Sonic drill core of quartz-sericite schist contained fluorite and pyrite from lot 2, Concession V, Walker Township (OGS 1988b) and this area is very prospective for gold mineralisation.

Gold-bearing quartz veins hosted within quartz-feldspar porphyry occur in lot 7, Concession V, Carr Township. A single assay of 1030 grams gold per ton over 0.3 m was reported by Pentland Firth Ventures Limited (1995) and was accompanied by visible gold in diamond drill core. Lower grade mineralisation of 0.52 gram gold per ton over 23.7 m and 0.34 gram gold per ton over 30 m accompanied disseminated and stringer copper mineralisation in the porphyry. This style of mineralisation has not been previously documented and, based on the limited data, a porphyry-style copper-gold model may be applicable (McMillan and Panteleyev 1988). There is good potential for low-grade, high-tonnage deposits in this environment and further exploration is strongly recommended.

Recommendations to Prospectors

BASE METALS

Copper-zinc and lead mineralisation is associated with chloritised, sericitized and silicified felsic and mafic metavolcanic rocks in the Kidd–Munro assemblage in southwestern Wilkie Township. Geochemistry indicates that the felsic rocks are similar to F-III rhyolites known to host base metal mineralisation at the Kidd Creek deposit and in Noranda, Quebec. The F-III felsic rocks were mapped to the east and west, however exploration has been most concentrated in Wilkie Township. There are several untested airborne electromagnetic conductors in lots 2 to 4, Concession II, Walker Township which are associated with the F-III felsic metavolcanic rocks (OGS 1984b). It is recommended that this area be explored.

The tonalitic intrusion in southern Wilkie Township is geochemically similar to the F-III felsic metavolcanic rocks 2 km to the northwest. Any airborne or ground electromagnetic conductor associated with the intrusion should be tested for its base metal potential. Similarly, felsic intrusive rocks associated with the Montclerg gold deposit in Clergue Township are geochemically similar to nearby F-III rhyolites and any electromagnetic conductor in this area should be tested.

Kidd–Munro assemblage felsic metavolcanic rocks with F-III geochemical characteristics occur in lots 3 to 8, Concession I, Clergue Township. Pyrite and graphite in amygdaloidal mafic metavolcanic rocks occur in the stratigraphic footwall of the felsic rocks and are associated with airborne electromagnetic conductors (OGS 1984a). Untested airborne electromagnetic conductors in lots 8 to 10, Concession I are along strike of the felsic rocks and should be explored. North-northeasterly striking faults, parallel to the stratigraphy, occur in this part of the Monteith area and are coincident with some of the inferred fold axes. It is possible that thrusting occurred along these faults and the geology is more complicated that portrayed on Map P.3367 (back pocket). The entire southwestern part of Clergue Township and northwestern part of Stock Township (Muir 1995) should be evaluated for base and precious metal mineralisation with particular emphasis on tracing the felsic metavolcanic rocks and the fault structures.

Felsic metavolcanic rocks in the Duff–Coulson–Rand assemblage underlie the northern parts of Walker and Wilkie townships. Geochemistry indicates that these rocks are similar to F-I rhyolites that are not known to host major base metal deposits (Lesher et al. 1986). Nevertheless, elevated copper and zinc assays were returned from graphitic schist interbedded with felsic rocks in lot 3, Concession V, Walker Township and pyrite was reported from diamond drill holes in lot 11, Concession IV, Wilkie Township. There remain a number of untested airborne electromagnetic conductors throughout this area and it is possible that base metals are associated with some of them (OGS 1984b, 1984c).

Copper-zinc-nickel mineralisation is reported to occur within intermediate metavolcanic rocks and ultramafic rocks of Dundonald Sill in lot 10, Concession III, Clergue Township. Although no mineralisation was discovered along strike, a number of diamond drill holes failed to reach bedrock or did not adequately explain the electromagnetic conductor. Felsic metavolcanic rocks are reported from lots 9 and 10, Concession II, Clergue Township and several strong airborne electromagnetic conductors remain untested throughout the western part of Clergue Township (OGS 1984a). It is recommended that this area be tested for base metal mineralisation; in particular, conductors in lot 9, Concessions II and III and in lots 9 and 12, Concession II may prove interesting.

The Alexo mine extracted nickel-copper mineralisation from komatiitic rocks 80 m west of the map area in Dundonald Township. These rocks extend into Clergue Township where they are interlayered with the intermediate metavolcanic rocks and were intruded by members of the Dundonald Sill. As there is very little outcrop in the map area and the komatiites and Dundonald Sill display similar magnetic intensity, it is difficult without extensive diamond drilling to distinguish between the sill and other ultramafic rocks. Similarly, it is difficult to separate airborne electromagnetic conductors that might be associated with base metal mineralisation from komatiitic-hosted nickel-copper mineralisation. Any conductor in the vicinity of the Dundonald Sill must be considered as a potential exploration target.

Porphyry-style copper and gold mineralisation associated with calc-alkalic quartz-feldspar porphyry intruded clastic metasedimentary rocks of the Hoyle assemblage in Carr Township. The intrusion was hematized, silicified and albitized by white mica alteration. The intrusion displays higher magnetic susceptibility than the Hoyle assemblage and second derivative vertical magnetic gradient maps reveal an intrusion covering approximately 16 km^2. Ground magnetic and induced polarisation surveys have been successfully used to explore part of the northern contact of the porphyry with the metasedimentary rocks, however most of the contact and the interior of the intrusion have not been explored. There is much untested potential for large-tonnage, low-grade copper-gold mineralisation and it is strongly recommended that the entire intrusion be explored. Second derivative vertical gradient magnetic and sonic drill data indicate that additional porphyry bodies intruded the Hoyle assemblage in the central part of Taylor Township. No exploration is reported in these areas (*see* Map P.3367) and it is recommended that these intrusions be tested for their copper-gold potential.

GOLD

All gold deposits and most of the occurrences are spatially associated with either the Porcupine–Destor deformation zone or the Pipestone fault. The gold mineralisation in central Carr Township is associated with quartz-feldspar porphyry and there is some evidence that the high-grade quartz veins are structurally controlled.

Pipestone Fault

The Montclerg deposit is hosted in felsic intrusive rocks that have geochemical characteristics similar to F-III rhyolites (Lesher et al. 1986). Previous exploration was concentrated west of the Driftwood River; however, the most recent work encountered gold mineralisation east of the river in an east-northeast-striking shear zone that is here inferred to be a splay fault north of the Pipestone fault. The potential for discovery of additional mineralisation is very good northeast and southwest of the known deposit. Diamond drilling northeast of the deposit should be concentrated on locating the shear zone and host felsic rocks. As pyrite and arsenopyrite are common accessory minerals and occur in concentrations up to 10%, induced polarisation (IP) and sensitive ground magnetic surveys may prove useful exploration methods. Southeast of the deposit, any mineralisation distributed within the Pipestone fault and any northeasterly trending structure will be difficult to trace, however IP and magnetic surveys may still be useful. Exploration south of the Pipestone fault, in Stock Township, may be less rewarding as this area is underlain by the Hoyle assemblage and gold mineralisation is likely to be more dispersed in the metasedimentary rocks.

Gold mineralisation in northeastern Carr and southern Wilkie townships is contained within narrow quartz veins within strained rocks of the Hoyle and Kidd–Munro assemblages near the Pipestone fault. Gold tenor is weak and, to date, exploration has not discovered any significant resource. This part of the Pipestone fault may have been characterised by compression and future exploration should look for localised tensional structures. Easterly or northeasterly trending shear zones or faults would be the preferred orientation and the subvolcanic tonalite intrusion would be the preferred host for such structures.

Other parts of the Pipestone fault are poorly explored in the map area and this may be due to much of the land being patented. In general, where faults cross (as in lot 5, Concession I, Walker Township) or where there is a change in orientation of the Pipestone fault (lots 11 and 12, Concession I, Wilkie Township) there is enhanced potential for gold mineralisation.

Porcupine–Destor Deformation Zone

The Shoot Zone, West Porphyry and Porphyry Zone gold deposits in Taylor Township were being explored at the time of writing (February, 1997) and St Andrew Goldfields Limited were evaluating the mining feasibility of the

Shoot and West Porphyry deposits. The Shoot Zone is hosted in a southerly dipping metasedimentary wedge tectonically interleaved within altered ultramafic metavolcanic rocks of the Bowman assemblage. Although the metasedimentary wedge appeared to have been well defined in two dimensions there remained potential for additional tonnage down-plunge to the east. Surface geophysical surveys carried out in 1996 were being evaluated at the time of writing and there appeared to be potential targets southwest of the Shoot Zone. It is also possible that other tectonically interleaved metasedimentary rocks could be present elsewhere in the immediate area or along strike. The geometry of these "wedges" may continue to depth as "pinch-and-swell" structures in this vertical shear zone system. Geochemical sampling of the surficial media, although not as yet definitive, shows promise as an exploration tool (Hamilton et al. 1995; Bajc 1996)

Gold mineralisation at the West Porphyry and Porphyry zones is contained in flat-lying quartz vein stockworks hosted in hydrothermally altered mafic, ultramafic metavolcanic and trondjhemitic intrusive rocks. The flat-lying veins are interpreted by the author to represent tensional features within a vertically developed shear zone system. As such, there is potential for stacked, *en échelon* ore bodies near the boundaries of the deformation zone and specifically at depth to the north of the West Porphyry Zone. The alteration associated with these two deposits is characterised by enrichment in sodium, phosphorus and high field strength elements (Zr, REE, Hf), that is, geochemically affiliated with fenitization (King and Kerrich 1987) and this suggests that alkaline magmatism may be involved in the genesis of the gold deposits (Robert 1997).

Farther east along the Porcupine–Destor deformation zone, several other gold occurrences are reported. The Goldex, Jeffris and Parson occurrences display many geological similarities to the deposits described above which suggests that similar exploration strategies may be successfully employed. Trondjhemitic and syenitic dikes are reported at the gold occurrences and this indicates that alkaline magmatism may have played a role in localising the gold mineralisation. Further exploration is particularly recommended at the Jeffris occurrence as there has been no work reported since the 1930s and the work that is reported is poorly documented.

High-grade, gold-bearing quartz veins occur within the calc-alkalic quartz-feldspar porphyry intrusion in Carr Township. The geology and genesis of these veins are poorly explored and there remains potential for additional discoveries in this area. Exploration personnel at Pentland Firth Ventures Limited (the current mining claims holder) indicated that the veins may be localised in northeast-striking structures which cut the porphyry and this theory requires testing. The discovery of this mineralisation in a part of the map area formerly thought to have low mineral potential should cause re-evaluation of the entire Hoyle assemblage and similar geological environments.

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Appendix 1

Table 2. Geochemistry for the Kidd–Munro assemblage: Monteith area.

Sample Name		96-414	96-419	96-434	96-435	96-440	96-444	96-448	96-463	96-465	96-466	96-471
Locality 1	UTM	515930	514187	518663	518964	523515	525075	525452	528742	531283	531367	521757
Locality 2	UTM	5390000	5389023	5386271	5385581	5390150	5388185	5390448	5391951	5388432	5388302	5385725
Township		Clergue	Clergue	Clergue	Clergue	Walker	Walker	Walker	Walker	Walker	Walker	Clergue
Rock Type		Pillowed Andesite	Andesite	Rhyolite Flow	Massive Basalt	Massive Basalt 1%Pl	Plag-phyric Flow	Plag-phyric Flow	Massive Basalt	Coalesced Varioles	Pillow Rim-variole	Cumulate UM
Mg Number		52.54	49.29	18.26	57.22	57.99	43.66	60.17	36.59	29.40	32.16	83.93
SiO2	%	53.31	57.75	76.22	43.98	47.66	49.69	44.67	48.39	72.51	28.59	45.15
TiO2		1.25	1.29	0.10	1.75	0.77	0.70	0.77	1.86	0.82	3.66	0.24
Al2O3		18.66	16.41	9.75	15.17	13.42	17.48	14.55	12.82	10.51	21.52	4.35
Fe2O3*		5.76	5.99	2.66	13.18	12.77	9.43	13.15	17.78	2.33	27.20	10.68
MnO		0.16	0.09	0.02	0.17	0.21	0.24	0.20	0.27	0.05	0.55	0.09
MgO		3.22	2.94	0.30	8.90	8.90	3.69	10.03	5.18	0.49	6.51	28.16
CaO		7.32	6.99	0.39	10.43	11.74	13.09	10.46	8.44	4.25	2.94	0.58
Na2O		6.27	4.10	3.31	2.00	1.37	0.95	2.18	2.56	4.48	0.15	0.11
K2O		-0.02	-0.02	3.06	0.42	0.20	0.18	-0.02	0.05	1.02	2.47	0.03
P2O5		-0.01	0.10	-0.01	0.22	0.04	0.04	0.05	0.14	0.19	0.67	0.02
LOI		2.77	3.46	0.76	3.51	2.81	4.58	3.64	2.19	2.95	4.43	8.00
TOTAL		98.69	99.10	96.56	99.73	99.89	100.07	99.68	99.68	99.60	98.69	97.41
Rb	ppm	2.3	2.70	42.0	13.0	4.8	3.2	1.9	4.7	27	63.0	0.65
Sr		260	160	27	180	110	190	84	100	51	160	6.8
Nb		2.4	5.3	42.0	5.5	1.5	1.1	1.4	5.7	24.0	24.0	0.45
Zr		62	92	294	101	42	37	40	116	399	328	17
Y		18	28	164	24	19	15	20	46	82	82	7
Ni		50	220	6	120	110	130	130	53	20	30	1800
Co		20	51	-5	40	50	50	50	50	10	50	110
Sc		43	40	2	32	42	34	41	42	12	47	14
V		160	280	-5	220	260	240	260	480	58	180	97
Cu		-5	9	6	10	140	100	100	130	30	75	40
Zn		28	40	27	74	88	82	78	140	35	300	51
La		2.5	5.6	57	4	1.5	1.3	1.3	5.7	30	20	0.52
Ce		5.4	15	140	12	4.4	3.6	4	17	79	55	1.5
Pr		0.78	2.2	20	2	0.74	0.6	0.7	2.7	11	8.5	0.24
Nd		4	11	91	11	4.2	3.2	4	14	49	41	1.2
Sm		1.4	3.2	25	3.3	1.6	1.2	1.6	4.8	12	12	0.43
Eu		0.86	1.1	2.4	1.1	0.59	0.52	0.57	1.5	2	3.8	0.11
Gd		2	4	29	3.9	2.2	1.7	2.3	6.4	13	12	0.53
Tb		0.37	0.66	4.8	0.63	0.4	0.3	0.4	1.1	2.2	1.9	0.09
Dy		2.6	4.4	31	4	2.8	2.2	2.8	7.5	14	12	0.66
Ho		0.56	0.91	6.2	0.81	0.6	0.48	0.59	1.6	2.9	2.4	0.13
Er		1.8	2.7	18	2.3	1.8	1.4	1.8	4.6	8.2	7	0.44
Tm		0.25	0.38	2.6	0.31	0.25	0.2	0.25	0.66	1.2	0.99	0.06
Yb		1.7	2.5	17	2	1.7	1.4	1.7	4.2	7.6	6.6	0.45
Lu		0.26	0.39	2.6	0.31	0.26	0.2	0.25	0.61	1.1	1	0.07
Cs		0.18	0.28	0.48	0.33	0.28	0.1	0.26	2.5	0.74	6.1	1
Hf		1.2	2.2	13	2	0.91	0.69	0.82	2.4	9.5	5.4	0.36
Th		0.1	0.34	6.6	0.2	0.11	0.1	0.09	0.45	3.4	1.7	0.05
U		0.03	0.09	1.7	0.05	0.03	0.03	0.03	0.15	0.79	0.39	0.02
Ta		0.28	0.35	2.9	0.36	0.12	0.16	0.15	0.4	1.5	1.5	0.06

Table 2. continued.

Sample Name		96-478	96-492	96-496	96-504	96-511	96-516	96-517	96-521	96-534	96-535	96-420, 6301	96-421, 6302	96-423, 6303
Locality 1	UTM	536491	523141	542079	527953	537770	533830	534956	539717	541067	541067	514029	521184	521607
Locality 2	UTM	5389702	5386046	5387006	5387370	5389244	5388782	5388715	5387016	5387935	5387840	5388935	5391911	5386279
Township		Wilkie	Clergue	Wilkie	Walker	Wilkie	Wilkie	Wilkie	Wilkie	Wilkie	Wilkie	Clergue	Clergue	Clergue
Rock Type		Cumulate UM	Tonalite-Trondjhemite	Pillowed Basalt	Felsic Flow	Spinifex UM	Flow-banded Felsic	Massive Basalt	Massive Basalt	Plag-phyric Flow	Massive Basalt	Dacite Flow	Basalt	Massive Basalt
Mg Number		79.09	21.99	31.29	19.60	76.11	39.57	42.61	46.93	48.64	41.90	43.26	40.87	58.02
SiO2	%	44.25	75.53	50.67	73.29	39.67	65.91	49.32	48.93	48.38	49.67	59.49	48.80	46.66
TiO2		0.45	0.14	1.62	0.17	0.50	0.34	1.28	1.96	0.99	1.31	1.21	1.73	1.67
Al2O3		7.79	11.22	13.34	12.30	9.95	13.91	13.28	14.94	14.90	13.47	16.78	13.48	12.99
Fe2O3*		11.39	2.60	13.87	2.68	13.37	2.48	14.75	13.75	12.84	15.05	4.26	15.73	15.00
MnO		0.19	0.03	0.32	0.03	0.21	0.03	0.23	0.18	0.25	0.22	0.08	0.22	0.20
MgO		21.75	0.37	3.19	0.33	21.51	0.82	5.53	6.14	6.14	5.48	1.64	5.49	10.47
CaO		7.81	1.13	10.02	0.91	8.42	4.94	9.69	6.14	11.01	9.82	10.57	7.97	7.67
Na2O		0.24	5.09	1.87	5.05	0.15	3.36	2.14	3.40	1.91	1.65	2.76	3.08	2.22
K2O		0.07	0.94	0.16	1.78	0.07	1.35	0.05	0.78	0.37	0.14	0.06	0.20	0.30
P2O5		0.03	0.01	0.11	0.01	0.03	0.07	0.09	0.16	0.06	0.09	0.16	0.16	0.20
LOI		5.82	1.73	4.96	2.15	6.53	6.48	2.84	2.81	2.91	2.78	3.13	3.41	2.60
TOTAL		99.79	98.79	100.13	98.70	100.41	99.69	99.20	99.19	99.76	99.68	100.14	100.27	99.98
Rb	ppm	1	26	12	45	3.5	44	2.3	15.0	11	3.5			
Sr		18	47	100	52	14	82	180	240	110	170			
Nb		1.0		4.0		0.75	5.5	4.0	8.2	3.0	5.8	-5.0	-5.0	-5.0
Zr		30	377	91	365	31	139	87	104	63	104	74	98	92
Y		12	204	36	222	14	13	32	25	25	37	20	38	26
Ni		970	-5	50,	-5	610	10	63	1100	96	50	235	70	260
Co		77	-5	40	-5	77	5	40	40	50	50	55	40	40
Sc		22	2	44	3	29	5	41	24	41	38	38	44	26
V		160	-5	400	-5	200	40	320	220	290	330	245	375	220
Cu		10	-5	98	8	40	30	140	71	120	130	120	135	65
Zn		79	440	120	300	87	62	93	110	94	110	135	300	80
La		1.3	73	3.9	70	0.83	15	3.8	6	2.7	5.2	5.00	6.00	5.00
Ce		3.6	660	11	640	2.4	29	11	16	7.8	14	12.00	15.00	17.00
Pr		0.54	27	1.9	27	0.43	3.4	1.7	2.6	1.3	2.3	-5.00	-5.00	-5.00
Nd		2.7	120	10	120	2.4	13	9.1	13	6.9	12	10.00	11.00	16.00
Sm		0.94	31	3.5	32	1	2.6	3.1	3.8	2.5	3.8	2.50	3.80	3.80
Eu		0.35	3.3	1.2	3	0.37	0.77	0.99	1.4	0.81	1.2	1.20	1.30	1.40
Gd		1.3	33	4.8	33	1.5	2.3	4.2	4.5	3.2	5	-5.00	-5.00	5.00
Tb		0.23	5.4	0.82	5.4	0.29	0.35	0.75	0.71	0.57	0.88	0.70	1.00	1.00
Dy		1.6	32	5.7	31	2	1.9	4.9	4.3	2.4	3.7	4.40	7.40	4.90
Ho		0.33	6.6	1.2	6	0.43	0.36	1.1	0.86	0.82	1.2	1.00	1.80	1.30
Er		0.99	19	3.5	18	1.3	1.1	3.1	2.4	2.4	3.7	-5.00	5.00	1.40
Tm		0.14	2.9	0.49	2.7	0.19	0.16	0.46	0.32	0.33	0.52	-0.50	-0.50	-0.50
Yb		0.98	19	3.1	18	1.2	1.1	2.9	2	2.1	3.4	2.00	3.60	2.20
Lu		0.15	2.9	0.44	2.8	0.2	0.17	0.39	0.3	0.31	0.52	0.30	0.60	0.40
Cs		0.61	0.62	0.49	1.7	0.61	2.4	0.15	0.46	0.3	0.22	-1.00	-1.00	-1.00
Hf		0.75	14	1.4	15	0.83	3.7	1.3	1.9	1.2	2.1			
Th		0.17	7.6	0.24	8.9	0.08	2.6	0.27	0.49	0.16	0.43			
U		0.04	1.8	0.07	2.1	0.03	0.62	0.08	0.1	0.05	0.11			
Ta		0.09	3.4	0.28	3.8	0.08	0.54	0.27	0.48	0.2	0.38			

Table 2. continued.

Sample Name		96-425, 6304	96-428, 6305	96-430, 6306	96-431, 6307	96-438, 6308	96-439, 6309	96-441, 6310	96-443, 6311	96-445, 6312	96-446, 6313	96-464, 6315	96-474, 6317	96-477, 6319
Locality 1	UTM	521707	519312	519125	519089	520724	522285	523501	528595	524872	524179	531283	534932	534636
Locality 2	UTM	5386614	5386349	5386313	5386463	5390394	5387833	5389938	5386911	5388801	5392094	5388432	5388442	5387688
Township		Clergue	Clergue	Clergue	Clergue	Clergue	Clergue	Walker	Walker	Walker	Walker	Walker	Wilkie	Wilkie
Rock Type		QFP	Flow-banded Felsic	Massive Rhyolite	Massive Flow	Pillowed Basalt	Pillowed Basalt	Massive Basalt	Massive Dacite	Massive Basalt	Massive Basalt	Coalesced Varioles	Felsic Lapilli Tuff	Massive Basalt
Mg Number		41.58	24.10	17.40	54.60	45.46	36.78	43.01	41.07	52.78	28.81	39.29	27.28	45.77
SiO2	%	73.53	78.60	77.87	53.96	44.79	50.08	49.54	74.93	50.15	50.83	70.45	70.65	46.31
TiO2		0.25	0.12	0.10	1.03	1.74	1.51	1.76	0.27	0.91	2.13	0.89	0.34	2.20
Al2O3		11.01	11.19	9.70	14.69	16.60	13.09	13.23	10.82	13.98	11.95	11.59	12.22	12.91
Fe2O3*		3.45	2.37	0.94	10.31	15.23	13.31	15.85	3.24	12.35	17.91	6.15	4.33	18.98
MnO		0.05	0.04	0.02	0.15	0.24	0.00	0.22	0.04	0.20	0.24	0.08	0.07	0.24
MgO		1.24	0.38	0.10	6.26	6.41	3.91	6.04	1.14	6.97	3.66	2.01	0.82	8.09
CaO		2.21	1.97	0.35	6.79	8.34	11.58	8.18	1.06	11.04	7.19	4.78	1.90	4.20
Na2O		1.16	4.38	0.43	2.94	2.90	1.77	2.42	4.53	1.80	4.30	2.96	3.35	0.90
K2O		2.86	0.54	7.90	1.40	0.74	0.10	0.28	1.38	0.14	0.26	0.08	1.28	-0.02
P2O5		0.04	0.04	0.05	0.16	0.20	0.12	0.18	0.06	0.10	0.26	0.20	0.10	0.30
LOI		1.70	0.74	0.23	2.85	3.30	4.89	2.94	0.91	2.95	1.72	1.78	2.63	6.23
TOTAL		97.50	100.37	97.69	100.54	100.49	100.36	100.64	98.38	100.59	100.45	100.97	97.69	100.34
Rb	ppm													
Sr														
Nb		20.0	35.0	25.0	-5.0	-5.0	-5.0	-5.0	25.0	-5.0	-5.0	15.0	10.0	-5.0
Zr		332	328	282	120	94	74	98	360	62	178	426	300	230
Y		148	180	102	28	28	30	36	136	24	62	84	52	38
Ni		15	15	20	45	165	60	60	10	50	10	35	15	60
Co		-5	-5	-5	30	45	45	30	-5	30	30	15	5	45
Sc		4	2	2	34	43	48	44	6	43	40	19	7	40
V		10	-5	-5	235	305	395	400	15	275	245	75	25	325
Cu		15	10	15	150	100	115	100	5	100	55	50	15	-5
Zn		60	75	35	60	105	95	95	40	70	110	60	100	120
La		46.00	56.00	47.00	8.00	7.00	4.00	6.00	56.00	2.00	11.00	38.00	29.00	8.00
Ce		98.00	122.00	104.00	18.00	18.00	10.00	14.00	125.00	7.00	24.00	81.00	56.00	21.00
Pr		12.00	19.00	15.00	-5.00	-5.00	-5.00	-5.00	15.00	-5.00	-5.00	10.00	6.00	-5.00
Nd		69.00	78.00	63.00	14.00	17.00	8.00	11.00	88.00	-5.00	24.00	58.00	28.00	18.00
Sm		16.70	19.60	16.80	3.00	4.20	2.90	3.90	21.00	2.00	6.40	11.40	7.00	4.80
Eu		2.60	2.20	1.90	1.10	1.10	1.10	1.50	3.10	0.80	2.00	2.00	1.70	1.80
Gd		20.00	22.00	17.00	-5.00	-5.00	-5.00	-5.00	20.00	-5.00	9.00	11.00	7.00	5.00
Tb		3.50	3.90	2.90	-0.50	1.00	0.80	1.00	3.70	0.50	1.30	1.90	1.30	1.20
Dy		29.30	30.20	24.00	5.00	6.00	5.50	6.00	26.00	3.20	10.10	14.80	8.90	6.60
Ho		6.40	6.60	5.20	1.10	1.30	1.40	1.50	5.50	0.80	2.50	3.30	2.50	1.50
Er		23.00	18.00	16.00	-5.00	-5.00	-5.00	-5.00	18.00	-5.00	7.00	10.00	6.00	-5.00
Tm		3.00	2.00	2.00	-0.50	0.50	0.50	0.50	3.00	-0.50	-0.50	1.50	1.00	0.50
Yb		14.80	14.60	11.00	2.30	2.50	3.40	3.70	14.60	2.50	6.00	9.20	5.10	3.50
Lu		2.30	2.30	1.70	0.30	0.50	0.50	0.60	2.30	0.40	0.90	1.40	0.80	0.60
Cs		3.00	2.00	2.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	2.00	-1.00
Hf														
Th														
U														
Ta														

Table 2. continued.

Sample Name		96-476, 6320	96-482, 6321	96-494	96-494, 6322	96-495, 6323	96-505, 6327	96-509, 6326	96-518
Locality 1	UTM	534578	539794	539786	539786	539886	527953	536907	534956
Locality 2	UTM	5387907	5386390	5385712	5385712	5385842	5387370	5388013	5388715
Township		Wilkie	Wilkie	Wilkie	Wilkie	Wilkie	Walker	Wilkie	Wilkie
Rock Type		Spherulitic Flow	Massive Rhyolite	Tonalite	Tonalite	Massive Mafic	Felsic Flow	Felsic Flow	Cumulate UM
Mg Number		46.47	37.89	31.37	27.14	43.95	30.24	41.75	77.51
SiO2	%	51.03	75.48	77.77	78.57	47.34	75.11	78.47	39.10
TiO2		1.87	0.36	0.12	0.15	1.65	0.18	0.23	0.58
Al2O3		9.88	11.63	11.14	11.85	13.68	11.61	9.54	9.82
Fe2O3*		15.31	1.98	1.69	2.18	17.20	3.61	1.05	13.72
MnO		0.44	0.06	0.02	0.03	0.21	0.03	0.03	0.18
MgO		6.71	0.61	0.39	0.41	6.81	0.79	0.38	23.88
CaO		4.10	2.13	1.19	1.33	7.12	0.55	1.92	4.34
Na2O		0.10	0.86	5.50	4.13	3.25	4.80	0.57	-0.01
K2O		0.34	4.46	-0.02	1.16	0.10	1.40	2.58	0.02
P2O5		0.42	0.08	0.01	0.04	0.18	0.06	0.06	0.04
LOI		8.73	1.90	1.01	1.11	3.21	1.15	2.75	7.73
TOTAL		98.93	99.55	98.82	100.96	100.75	99.29	97.58	99.40
Rb	ppm			5.8					0.28
Sr				61	22				9
Nb		-5.0	15.0		60.0	5.0	30.0	10.0	1.2
Zr		646	444	246	344	106	382	326	37
Y		68	76	208	242	40	228	50	16
Ni		5	5	-5	5	70	15	10	1100
Co		15	-5	-5	-5	30	-5	-5	98
Sc		31	8	2	3	49	3	7	25
V		75	10	-5	-5	370	5	-5	200
Cu		10	15	-5	5	5	120	20	120
Zn		145	30	23	25	95	120	30	130
La		12.00	35.00	71	70.00	6.00	68.00	27.00	0.94
Ce		32.00	70.00	570	140.00	14.00	167.00	63.00	3.7
Pr		5.00	8.00	24	20.00	-5.00	21.00	6.00	0.65
Nd		27.00	42.00	97	96.00	11.00	124.00	40.00	3.4
Sm		7.80	10.80	26	20.70	3.80	27.00	7.10	1.3
Eu		4.60	2.10	2.8	2.70	1.60	2.80	1.50	0.37
Gd		9.00	10.00	29	22.00	-5.00	30.00	7.00	1.8
Tb		1.50	1.80	5.2	4.90	1.00	5.60	1.40	0.32
Dy		11.60	12.50	36	32.30	5.60	40.00	9.60	2.2
Ho		2.40	2.70	8	7.20	1.50	8.60	2.00	0.48
Er		8.00	8.00	26	20.00	-5.00	28.00	6.00	1.5
Tm		1.00	1.00	4.2	3.00	0.60	4.00	1.00	0.21
Yb		7.10	7.60	29	24.70	3.30	22.10	4.60	1.4
Lu		1.20	1.20	4.4	3.80	0.60	3.40	0.70	0.19
Cs		-1.00	3.00	0.42					0.34
Hf				13					1
Th				7.7					0.28
U				1.8					0.09
Ta				5.4					0.12

Table 2. continued.

Sample Name		96-518, 6332	96-520, 6330	96-525, 6329	96-415	96-416	96-417	96-418
Locality 1	UTM	534956	534956	535093	515930	516342	516342	514900
Locality 2	UTM	5388715	5388715	5388182	5390000	5390363	5390403	5389858
Township		Wilkie	Wilkie	Wilkie	Clergue	Clergue	Clergue	Clergue
Rock Type		Spinifex UM	Felsic Flow	Altered Felsic	Pyroxenite	Peridotite	Gabbro-Pyroxenite	Gabbro
Mg Number		79.58	41.14	63.03	69.99	78.07	68.44	23.37
SiO2	%	41.95	77.39	73.88	50.27	42.11	46.57	52.66
TiO2		0.48	0.26	0.20	0.68	0.38	1.20	1.64
Al2O3		9.82	11.23	10.67	4.89	2.75	7.01	12.61
Fe2O3*		12.25	1.02	4.03	11.88	13.94	12.13	17.27
MnO		0.16	0.02	0.04	0.21	0.21	0.25	0.27
MgO		24.11	0.36	3.47	13.99	25.06	13.28	2.66
CaO		4.16	1.51	0.22	15.64	8.27	17.66	6.80
Na2O		0.27	3.99	0.34	1.01	0.26	0.29	4.38
K2O		0.08	1.52	2.52	0.18	0.07	0.04	-0.02
P2O5		0.06	0.08	0.06	0.04	0.02	0.04	0.15
LOI		7.56	1.72	2.69	1.97	5.86	2.55	1.70
TOTAL		100.90	99.10	98.12	100.76	98.93	101.02	100.12
Rb	ppm				3.6	1.1	1.2	2.5
Sr					37	10	15	190
Nb		5.0	10.0	35.0	1.9	1.7	3.2	9.3
Zr		30	298	424	40	26	66	164
Y		12	50	202	16	10	20	45
Ni		840	20	10	380	870	400	20
Co		75	-5	-5	50	110	54	40
Sc		29	4	3	47	23	45	19
V		165	10	15	210	120	330	130
Cu		20	5	-5	190	110	56	20
Zn		75	20	50	68	78	67	120
La		1.00	36.00	59.00	2.2	1.4	2.8	9.9
Ce		5.00	70.00	146.00	6.4	3.9	8.4	28
Pr		-5.00	8.00	21.00	1.1	0.62	1.5	4.4
Nd		-5.00	45.00	124.00	5.5	3.1	7.8	22
Sm		1.30	8.70	29.00	1.8	0.95	2.6	6.7
Eu		0.50	2.20	4.30	0.61	0.32	0.88	1.9
Gd		-5.00	7.00	30.00	2.2	1.2	3.2	7.8
Tb		-0.50	1.30	5.80	0.36	0.19	0.52	1.3
Dy		2.00	8.40	39.00	2.3	1.2	3.2	7.9
Ho		0.50	2.20	9.50	0.47	0.23	0.64	1.6
Er		-5.00	5.00	26.00	1.3	0.65	1.8	4.6
Tm		-0.50	-0.50	4.00	0.18	0.09	0.26	0.63
Yb		1.00	4.00	22.30	1.1	0.63	1.7	4.1
Lu		0.20	0.60	3.60	0.18	0.09	0.24	0.63
Cs					0.31	0.21	0.27	0.23
Hf					0.96	0.59	1.6	4.9
Th					0.18	0.12	0.3	0.92
U					0.06	0.03	0.08	0.29
Ta					0.19	0.13	0.24	0.63

TABLE 3 - GEOCHEMISTRY FOR BOWMAN ASSEMBLAGE: MONTEITH AREA

Sample Name		96-454, 6314	96-459, 6318	96-506	96-532	96-458	96-483	96-484	96-489
Locality 1	UTM	529947	531508	530385	536347	528542	539655	540140	542348
Locality 2	UTM	5377224	5378160	5379176	5378619	5379176	5376595	5375990	5375897
Township		Taylor	Taylor	Taylor	Carr	Taylor	Carr	Carr	Carr
Rock Type		Massive Basalt	Massive Basalt	Cumulate UM	Cumulate UM	Tonalite-Albitite	Feldspar Porphry	Massive Basalt	Massive Basalt
Mg Number		56.10	52.64	69.28	81.23	76.52	48.41	48.45	44.30
SiO2		51.17	49.88	31.88	46.06	67.01	64.95	50.42	49.57
TiO2	%	0.81	0.84	1.16	0.36	0.06	0.37	0.79	1.32
Al2O3		13.83	14.65	15.64	4.48	15.98	16.28	13.26	13.80
Fe2O3*		11.98	12.81	18.84	11.38	0.48	3.63	12.37	15.51
MnO		0.22	0.18	0.11	0.13	0.02	0.03	0.20	0.34
MgO		7.73	7.19	21.45	24.86	0.79	1.72	5.87	6.23
CaO		9.23	7.64	0.58	4.15	1.58	3.88	11.92	6.56
Na2O		2.85	3.22	-0.01	-0.01	9.98	5.17	1.28	4.11
K2O		0.20	0.18	-0.02	0.02	-0.02	0.34	0.24	-0.02
P2O5		0.08	0.10	0.32	0.02	0.14	0.12	0.05	0.08
LOI		2.03	3.36	9.71	8.57	2.16	1.65	3.48	2.27
Total		100.13	100.05	99.66	100.02	98.18	98.14	99.88	99.77
Rb	ppm			0.22	0.29	1.8	21	3.8	0.81
Sr				19	87	280	370	200	270
Nb		-5.0	-5.0	0.7	0.7	5.3	6.6	1.8	2.9
Zr		40	66	96	22	105	125	52	77
Y		18	26	28	8	8	11	21	29
Ni		45	55	340	1300	-5	30	69	100
Co		30	40	50	85	-5	8	40	40
Sc		47	46	30	17	-1	5	40	39
V		295	275	240	130	8	50	280	320
Cu		120	55	67	40	-5	110	120	9
Zn		50	70	120	71	9	31	85	160
La		2.00	3.00	12	0.75	28	18	2.3	3.8
Ce		7.00	7.00	32	2.3	61	38	6.4	10
Pr		-5.00	-5.00	4.5	0.36	7.6	4.4	1.1	1.7
Nd		5.00	6.00	20	1.8	30	16	5.5	8.8
Sm		1.40	2.10	4.5	0.62	5.3	2.8	1.9	2.8
Eu		0.50	0.80	0.82	0.12	1.2	0.81	0.72	0.83
Gd		-5.00	-5.00	3.6	0.85	3	2.4	2.6	3.8
Tb		-0.50	0.60	0.47	0.14	0.32	0.35	0.44	0.65
Dy		3.00	3.70	2.6	0.94	1.2	1.9	3.2	4.6
Ho		-0.50	0.90	0.57	0.19	0.16	0.36	0.68	0.95
Er		-5.00	-5.00	1.7	0.54	0.37	1.1	2.1	2.9
Tm		-0.50	-0.50	0.27	0.07	0.04	0.16	0.3	0.42
Yb		1.80	2.60	1.9	0.51	0.36	1.1	2	2.8
Lu		0.30	0.50	0.33	0.07	0.05	0.18	0.32	0.43
Cs				0.48	0.49	0.06	0.22	0.13	0.04
Hf				2.9	0.23	2.7	2.1	1.2	1.6
Th				1.6	0.07	1.2	3	0.19	0.3
U				0.62	0.02	1.2	0.71	0.06	0.08
Ta				0.08	0.08	0.54	0.5	0.15	0.22

TABLE 4 - GEOCHEMISTRY FOR DUFF-COULSON-RAND ASSEMBLAGE; MONTEITH AREA

Sample Name		96-472, 6316	96-501	96-501, 6328	96-512, 6331	96-468	96-502	96-513	96-530	96-462
Locality 1	UTM	523014	529564	529564	534242	518030	529564	534242	532086	527254
Locality 2	UTM	5394714	5393095	5393095	5391572	5393458	5393095	5391572	5392997	5394660
Township		Clergue	Walker	Walker	Wilkie	Clergue	Walker	Wilkie	Walker	Walker
Rock Type		Massive Mafic	Qtz-sericite Schist	Felsic Schist	Felsic Tuff	Lapilli Stone	Mafic Flow	Altered Felsic	Felsic Schist	Massive Mafic
Mg Number		42.65	39.41	39.83	49.43	45.32	58.00	44.55	26.91	57.54
SiO2	%	49.16	60.91	60.94	67.48	53.25	45.15	67.55	67.27	48.86
TiO2		1.18	0.49	0.53	0.29	0.76	0.79	0.28	0.37	0.61
Al2O3		16.06	14.04	15.47	15.02	16.23	13.29	14.11	15.25	15.03
Fe2O3*		15.23	4.11	3.53	2.35	8.34	7.80	2.49	4.68	10.74
MnO		0.24	0.08	0.07	0.03	0.08	0.17	0.03	0.02	0.16
MgO		5.72	1.35	1.18	1.16	3.49	5.44	1.01	0.87	7.35
CaO		2.42	4.66	3.71	2.67	5.11	7.49	2.90	0.77	11.49
Na2O		4.00	4.11	5.54	3.65	2.77	2.03	4.85	0.76	1.47
K2O		0.20	1.95	1.90	1.82	2.35	0.54	1.11	2.81	0.78
P2O5		0.12	0.11	0.18	0.12	0.20	0.06	0.06	0.09	0.04
LOI		4.63	7.78	6.43	3.64	6.85	16.66	5.21	5.01	3.50
Total		98.96	99.59	99.48	98.23	99.43	99.42	99.60	97.90	100.03
Rb	ppm		62			57	21	36	66	19
Sr			200	98		290	170	160	370	400
Nb		-5	5	10	-5	3.5	1.9	2.4	1.7	0.97
Zr		66	199	222	92	108	65	108	119	44
Y		22	17	26	4	17	19	7	9	17
Ni		105	20	10	30	69	40	20	40	40
Co		50	8	5	5	20	40	-5	10	10
Sc		33	7	7	5	15	32	3	7	7
V		220	190	55	50	140	240	30	60	60
Cu		130	-5	5	5	62	50	5	50	50
Zn		145	67	50	35	92	63	54	160	160
La		3.00	23	24.00	14.00	23	3.1	8.2	11	2.6
Ce		7.00	52	49.00	19.00	57	7.3	18	25	6.6
Pr		-5.00	6.6	5.00	-5.00	7.7	1	2.2	3	0.98
Nd		7.00	27	22.00	10.00	31	5	8.7	12	4.8
Sm		2.20	4.6	4.10	1.60	5.6	1.6	1.6	2.4	1.5
Eu		0.70	1.1	1.00	0.50	1.4	0.46	0.59	0.79	0.59
Gd		-5.00	3.6	-5.00	-5.00	4.1	1.7	1.2	1.8	2
Tb		0.50	0.51	-0.50	-0.50	0.53	0.27	0.17	0.24	0.33
Dy		3.20	2.6	3.10	0.80	2.7	1.7	0.82	1.3	2.4
Ho		0.80	0.54	0.70	-5.00	0.49	0.36	0.14	0.23	0.5
Er		-5.00	1.5	-5.00	-5.00	1.4	1.1	0.39	0.63	1.6
Tm		-0.50	0.22	-0.50	-0.50	0.19	0.15	0.05	0.09	0.22
Yb		2.00	1.5	1.50	0.50	1.3	1	0.36	0.63	1.5
Lu		0.30	0.23	0.20	0.10	0.2	0.17	0.05	0.1	0.23
Cs			2			4.2	2.1	1.1	6.2	0.27
Hf			4.3			2.7	1.2	3	3	0.97
Th			4.1			2.1	0.41	1.5	2.6	0.3
U			0.88			0.43	0.11	0.42	0.77	0.08
Ta			0.42			0.27	0.17	0.24	0.15	0.09

TABLE 5 - GEOCHEMISTRY FOR MISCELLANEOUS ROCKS FROM MONTEITH AREA

Sample Name		96-415	96-416	96-417	96-418	96-452	96-527	96-531	96-497 6324	96-498 6325	96-498	96-499
Locality 1	UTM	515930	516342	516342	514900	530260	536800	529299	535626	535626	535626	542140
Locality 2	UTM	5390000	5390363	5390403	5389858	5377431	5392805	5382119	5382778	5382778	5382778	5388712
Township		Clergue	Clergue	Clergue	Clergue	Taylor	Wilkie	Taylor	Carr	Carr	Carr	Wilkie
Rock Type		Pyroxenite	Peridotite	Gabbro-Pyroxenite	Gabbro	Matachewan Dike	Matachewan Dike	QFP Intrusion	QFP	QFP	QFP	Wacke
Mg Number		69.99	78.07	68.44	23.37	41.01	38.61	49.57	56.95	60.97	62.33	53.48
SiO2	%	50.27	42.11	46.57	52.66	50.14	53.07	66.52	66.93	66.58	67.74	57.61
TiO2		0.68	0.38	1.20	1.64	1.37	1.39	0.35	0.39	0.28	0.24	0.63
Al2O3		4.89	2.75	7.01	12.61	13.89	14.90	14.71	15.21	13.22	13.17	15.20
Fe2O3*		11.88	13.94	12.13	17.27	15.41	11.65	2.76	2.62	2.32	1.52	6.77
MnO		0.21	0.21	0.25	0.27	0.23	0.13	0.03	0.03	0.02	-0.01	0.11
MgO		13.99	25.06	13.28	2.66	5.41	3.70	1.37	1.75	1.83	1.27	3.93
CaO		15.64	8.27	17.66	6.80	9.23	5.94	3.22	1.48	3.12	2.76	6.24
Na2O		1.01	0.26	0.29	4.38	2.20	4.32	5.25	7.13	5.67	6.25	4.03
K2O		0.18	0.07	0.04	-0.02	0.96	1.07	1.17	0.74	1.14	0.70	1.27
P2O5		0.04	0.02	0.04	0.15	0.14	0.25	0.09	0.14	0.10	0.05	0.19
LOI		1.97	5.86	2.55	1.70	0.72	2.41	3.40	1.85	5.11	4.23	3.08
Total		100.76	98.93	101.02	100.12	99.70	98.83	98.87	98.27	99.39	97.92	99.06
Rb	ppm	3.6	1.1	1.2	2.5	30	25	43			28	23
Sr		37	10	15	190	153	468	514	31	790	343	300
Nb		1.9	1.7	3.2	9.3	6.3	9.7	4.0	-5	-5	1.6	4.8
Zr		40	26	66	164	126	183	123	94	88	88	140
Y		16	10	20	45	35	24	12	10	8	12	17
Ni		380	870	400	20	74	56	20	10	-5	10	87
Co		50	110	54	40	50	10	8	10	5	-5	20
Sc		47	23	45	19	34	17	6	9	5	4	14
V		210	120	330	130	310	230	55	45	75	50	120
Cu		190	110	56	20	130	65	-5	570	30	-5	40
Zn		68	78	67	120	130	110	36	25	10	10	84
La		2.2	1.4	2.8	9.9	14	34	14	18.00	6.00	5	34
Ce		6.4	3.9	8.4	28	32	73	32	39.00	15.00	13	79
Pr		1.1	0.62	1.5	4.4	30	9.2	4.3	-5.00	-5.00	1.9	10
Nd		5.5	3.1	7.8	22	18	37	18	23.00	9.00	9	41
Sm		1.8	0.95	2.6	6.7	4.8	7.3	4.3	3.90	2.50	2.4	6.8
Eu		0.61	0.32	0.88	1.9	1.4	1.9	1.1	0.90	0.60	0.54	1.6
Gd		2.2	1.2	3.2	7.8	5.3	6.1	3.5	-5.00	-5.00	1.9	4.7
Tb		0.36	0.19	0.52	1.3	0.86	0.85	0.47	-0.50	-0.50	0.25	0.61
Dy		2.3	1.2	3.2	7.9	5.7	4.4	2.3	1.80	2.00	1.2	2.8
Ho		0.47	0.23	0.64	1.6	1.2	0.82	0.39	-0.50	0.50	0.22	0.52
Er		1.3	0.65	1.8	4.6	3.5	2.2	1.1	-5.00	-5.00	0.54	1.4
Tm		0.18	0.09	0.26	0.63	0.5	0.31	0.14	-0.50	-0.50	0.09	0.2
Yb		1.1	0.63	1.7	4.1	3.4	1.9	0.98	0.90	1.10	0.66	1.4
Lu		0.18	0.09	0.24	0.63	0.54	0.28	0.15	0.10	0.20	0.1	0.21
Cs		0.31	0.21	0.27	0.23	0.91	0.61	2.2			0.7	0.23
Hf		0.96	0.59	1.6	4.9	3.4	4.7	3.4			2.1	3.7
Th		0.18	0.12	0.3	0.92	2.8	4.6	2.3			1.1	4.1
U		0.06	0.03	0.08	0.29	0.69	0.77	0.78			0.58	0.81
Ta		0.19	0.13	0.24	0.63	1.2	0.53	0.26			0.13	0.35

Appendix 2

TABLE 6 - Summary of Exploration Activity: Monteith Area

CLERGUE TOWNSHIP

COMPANY	LOCATION	LAST YEAR	WORK	RESULTS
Alexo Mines Limited	lot 12 Con III	1912	unknown dd	not reported
Alexo Extension Mines Limited		1943	airborne mag and EM surveys	no follow up reported
Amax Minerals Exploration (Amax of Canada Limited)	lots 1,3 Con VI	1982	2 ddh- 269 m	no assays reported
Amax Potash Limited	lot 5, Con I	1972	2 ddh -	no follow up reported
Angela Developments Limited	parts of Twp.	1986	airborne VLF-EM and mag	
Asarco Exploration of Canada Limited	lot 9, Con IV	1973	ground EM and mag surveys	no follow-up reported
Bell,D. and Mulliette, M	lot 1, Con I	1974	ground geophysics	no follow-up reported
Bird and Bourke				
Burke, E.	lot 2, Con III	1939	trenching	nil Au, minor asp
Canadian Nickel Company Limited	lots 9-12, Con II - III	1972	11 ddh - 3047 m	.8% Cu/2.3 m .46% Cu, .32% Ni, 1.15% Zn/3.7 m
Carlson, H.D.	lots 3-4 Con I	1975	ground mag and VLF	no follow up reported
Consolidated Montclerg Mines Limited	lots 1-3 Con I	1986	3 ddh - 439 m	0.12 opt/3.5 m, up to 2.7% As/.9 m
Dalhousie Oil Company Limited	lot 2, Con I	1980	1 ddh - 184 m	assays reported
Dominion Gulf Company	lots 10 -12, Con II-IV	1954	8 ddh - 1825 m	asbestos and magnetite reported. 0.24% Ni and .58% Cr/ .61 m
Falconbridge Nickel Mines Limited	lot 11, Con III	1972	2 ddh - 235 m	no assays reported
Grandora Exploration Limited	lot 11, Con III, IV	1969	Ground VLEM and mag surveys	no follow up reported
Hollinger Consolidated Gold Mines Limited	lots 10-12, Con I	1957	2 ddh - 412 m	nil Au, nil Ni reported

Ingex Holding and Development Limited	lots 9-10, Con I	1981	ground VLF-EM	no follow up reported
Kidd Creek Mines Limited	lots 4-6 Con I	1987	ground geophyical surveys, 1 ddh -	no significant results reported
Lac Minerals Limited	lot 6, Con IV	1985	1 ddh - 191 m	no assays reported
McKinnon, D.		1988	airborne VLF-EM and mag, geological interpretation	limited ground follow up, no diamond drilling
Montclerg Mines Limited	lots 1-3, Con I	1938-41	discovery and exploration of gold occurrence	371 008 tons @ .132 opt reported
Noranda Exploration Company Limited	lot 4, Con I	1975	ground mag	no follow up reported
Ontario Geological Survey		1987	4 sonic drill holes - 190.8 m	results reported Pmap. 2848
Salo, A.	lots 11-12, Con I	1995	ground geophysics, 1 ddh - 191 m	best results .59 g/t Au/.58 m
Selco Incorporated	lot 12, Con II	1960	1 ddh - 153 m	no assays reported
Surveymin Limited (Nahanni Mines Limited)	lot 3, Con I	1983	2 ddh - 560 m	169 ppb Au/1.5 m
Tarzan Gold Incorporated	lots 8-10, Con IV	1988	ground surveys	no follow up reported
Torrance, W.		1964	air EM survey	no follow up reported
Weston,	lot 5, Con I		1 ddh -	assays not reported

WALKER TOWNSHIP

COMPANY	LOCATION	LAST YEAR	WORK	RESULTS
Amax Minerals Exploration	lot 5, Con V; lot 3, Con IV; lot 2, Con I	1981-85	geology	very little outcrop found
Amax Minerals Exploration	lot 5, con V	1981	1 ddh - 114 m	no assays reported
Bell, D, Mulliette, M.	lots 9-12, Con I	1974	Ground EM and mag	covers part of Montclerg Au deposit
Canamax Resources Incorporated	township	1984-85	airborne EM and mag,	follow up on selected properties

Canamax Resources Incorporated	lot 12, con I	1986	geology, 1 ddh - 231 m	no assays reported
Carlson, H.D.	lots10-11, Con I	1981	3 ddh - 610 m	no assays reported
Cosby, M.S.	lots 5,6, Con V, VI	1986-94	HLEM, VLF-EM, mag, soil geochemistry Compilation	no significant results reported
Dominion Gulf Company	lot 1, 8, Con I	1955	ground mag and geology	no follow up reported
Falconbridge Limited	lots 1-2, Con II	1995	2 ddh - 245 m	no assays reported
Falconbridge Nickel Mines Limited	lot 12, Con I	1981	13 RCD - 226 m, geology, mag, EM	no follow up reported
Golden Grail Mineral Exploration Corporation	lot 8, Con I	1986	11 RCD - 219 m, IP and resistivity, 1 ddh -103 m	no assays reported
Hollinger Mines Limited	lots 1-4, Con V	1979	2 ddh - 296 m, mag	.005 opt Au, 4400 ppm Cu, 95 ppm Pb, 65 ppm Zn, 50 ppm Ni/.3 m
Hollinger Mines Limited	lots 6- 7, Con I	1979	1 ddh - 120 m	1400 ppm Zn/.6 m 280 ppm Cu/1.5 m .005 opt Au/1.5m
Kidd Creek Mines Limited	lots 1-2 Con II	1986	mag, VLF-EM, HLEM	ddh in Wilkie Twp (cf Falconbridge Limited)
Monpre Mining Company Limited	lot 1, Con I and II	1964	5 ddh - 643 m	best assays tr Au, .3% Cu, .5% Zn / .1 m
Montclerg Mines Limited	lots 11-12, Con I	1943	discovery and delineation of Au deposit	371 008 tons at .132 opt
Noranda Exploration Company Limited	lot 1, Con IV	1965	1 ddh - 156 m	no assays reported
Noranda Exploration Company Limited	lot 7, Con II	1980	5 ddh - 272 m	nil Au, nil Ag
Ontario Geological Survey	township	1985-88	9 RCD	results reported OGS Pmap 2848
Surveymin Limited (Nahanni Mines Limited)	lots 9, 11, Con I; lots 1-2, Con I	1980-81	2 ddh - 340 m, ground mag, EM and VLF-EM	470 ppb Au/.76 m
Tarzan Gold Incorporated	parts of lots 6-11, Con IV - V	1989	ground IP and mag	no follow up reported

WILKIE TOWNSHIP

COMPANY	LOCATION	LAST YEAR	WORK	RESULTS
Amax Minerals Exploration (Amax of Canada Limited)	lots 1-2 Con II, lots 1-5 Con III	1980	geology, 1 ddh- 177 m	best assays .03 ppm Au, .5 ppm Ag/1.5 m 534 ppmCu 5300 ppm Zn/1.5 m
Baulieu, Coderre, Thompson Group	lots 10-11, Con II	1939	property visit	tr Au from trenches
Booth, W.	lot 1, Con II	1988	trenching	no assays reported
Canamax Resources Incorporated	parts of lots 9-12, Con I	1987	ground geophysics 2 ddh -519 m	assays not reported
Continental Copper Mines Limited	lots 9-12, Con I, lots 9-10, Con II	1965	2 ddh - 421 m	no assays reported
Dominion Gulf Company		1955	ground geophysics	no follow up reported
Falconbridge Incorporated	lots 3-4, Con I, lots 8-12, Con II,	1996	ground geophysics geology many ddh	most assays not reported; signifcant Cu - Zn - Pb mineralization encountered in lots 8-12, Con II
Field Explorations Limited	lots 1-2 Con I	1966	prospectus	no field work reported
Fournier, E.	lots 2-5 Con II	1993	trenching, diamond drilling	best assay reported .17 opt Au/.3 m
Glen Auden Resources Limited	lots 5-8 Con III	1993	4 ddh	no assays reported
Hecla Mining Company of Canada Limited	lot 10, Con II	1970	1 ddh - 154 m	no assays reported
Hollinger Consolidated Gold Mines Limited	lot 7, Con II lot 12 Con I	1939	2 ddh - 127 m	no assays reported
Hollinger Mines Limited	lot 8, Con V, lots 3-5 Con I, II, lots 8-11, Con II	1980	AEM, ground geophysics, 5 ddh	.01 opt Au/1.5 m; no significant base metal assays from lot 8, Con V
Imperial Oil Limited	lots 6-7 Con II, III	1975	ground mag and VHEM surveys	no follow up reported
Kidd Creek Mines Limited	lot1, Con II, lots 10-12,	1987	ground geophysic, diamond drilling	most assays not reported; Cp and mc reported from

	Con IV, V, lots 3-4 Con I			trenches in lot 4, Con I
Mattagami Lake Exploration Limited	lots 11-12, Con IV, V	1980	ground geophysics and 3 ddh- 770 m	1.37 g/t Au/.7 m; .15% Cu, .08% Zn/1.01 m; 5.49 g/t Ag/.3m
Maude Lake Gold Mines Limited	lots 1-4 Con I	1987	ground mag, VLF-EM, radiometric 3 ddh - 444 m	.008 opt Au/.9m
McChristie, N.	lots 1, 4, Con I lot 1, Con IV	1983	stripping, 4 ddh	assays not reported
McIntyre Mines Limited	several lots	1974	ground mag and EM surveys	no follow up reported
Nahanni Mines Limited	lots 8-12 Con I	1981	5-ddh - 919 m	1570 ppb Au/.76 m from lot 10, Con I
Noranda Exploration Company Limited	lot 10-12 Con IV	1965	2 ddh - 237 m	nil Au, Ag reported
Noranda Exploration Company Limited	lot 10 Con II	1973	2 ddh - 92 m	1.44% Cu /4.6 m 1% Zn / 1.2 m
Ontario Geological Survey	twp	1987	8 sonic drill holes	results reported 1987
Pyke, D.R.	lot 1-3 Con I	1987	stripping, mag, RCD, VLF-EM, soil and rock geochem, geology	no significant results reported
Surveymin Limited (Nahanni Mines Limited)	lots 9-12, Con I	1981	VLF-EM, mag	see Nahanni Mines Limited for ddh results
Tarzan Gold Incorporated		1989	ground geophysics	no follow up reported
Twin Falls Syndicate	lots 2-3 Con IV	1965	ground geophysics 1 ddh - 169 m	no assays reported
Young - Davidson Mines Limited	lots 3,4,6,7 Con I	1965	ground EM	no reported follow up

PROPERTY LIST

TAYLOR TOWNSHIP

COMPANY	LOCATION	LAST YEAR	WORK	RESULTS
Bell, D.R. + Mulliette, M.	lot 12, Con VI	1974	Ground mag and EM	no follow up reported
Canamax Resources	lots 4, 6, Con	1985	AEM and Amag, geology	no follow up reported

Incorporated	IV, lots 10, 12, Con VI			
Chisholm, E.O.	lot 1, Con II	1984	1 ddh - 73 m	no assays reported
Esso Minerals Canada	lots 6-7, Con III	1984	compilation and pre-feasibility for "Porphyry Zone" gold deposit	no follow up reported
Esso Minerals Canada	lot 9, Con II	1984	compilation and pre-feasibility for "Shoot Zone" gold deposit	733 000 tons @ .163 opt Au
Goldex Resources Incorporated	lots 4-5, Con III	1986	9 ddh - 1476 m	assays .357 opt Au/.25m .329 opt Au/.6 m .18 opt Au /.33 m
Hollinger Consolidated Gold Mines Limited (Hollinger Mines and Hollinger Argus)	lots 6,7, Con III, lot 9, Con II	1938 - 1984	discovery, drilling and compilation of Porphyry and Shoot zones	definition of grade and tonnage of deposits
Montclerg Mines Limited	lot 12, Con VI	1976	geology, ground geophysics	no follow up reported
Ontario Geological Survey	township	1985 1987 1994	9 regional sonic drill holes - 19 sonic holes at Shoot Zone	results reported Pmap 2986, Hamilton et al, 1995
Pentland Firth Ventures Limited	lot 1, Con V	1995	ground mag survey	no follow up reported
Quebec Sturgeon River Mines Limited	lot 11, Con II	1983	6 ddh - 1327 m	best assay reported .119 opt Au/ 1.5 m
St Andrews Goldfields Limited (Taylor Mine)	lots 6, 7 Con II, III	1987	underground exploration at porphyry Deposit	26 945 tons @ .04 opt Au extracted 265 645 tons @ .071 opt Au reserves
Taylor Gold Mines Limited	lots 9-10 Con I lot 4, 6 Con III	1965	AEM, Amag	no follow up reported
Timmins Explorations (Ontario) Limited, N.A.	lots 4-7 Con II, III	1946	undisclosed amount of diamond drilling	gold assays to 0.1 opt/ .3 m reported
Turney, W. H.	lot 7, Con III	1969	4 ddh - 353 m	no follow up reported
Windfall Oils and Mines Limited	lot 7, Con IV	1973	Amag, ground VLF-EM, mag	no follow up reported

CARR TOWNSHIP

COMPANY	LOCATION	LAST YEAR	WORK	RESULTS
Asarco Exploration Company of Canada Limited	lots 5, 7, 8, Con II	1984	ground mag, VLF-EM, 1 ddh - 202 m	assays not reported
Black River Occurrence	lot 4, Con I	?	inclined shaft	gold assays to 4130 ppb reported OFR 5735
Canamax Resources Limited	several areas in twp.	1987	Amag and AEM, geology, 2 ddh - 329 m	discovery of porphyry Cu, Mo, Au in lot 7, Con V, assays not reported
Carr-Hislop Gold Syndicate (Carlo Showing)	lot 2, Con VI	1939	trenching	reported assays .4 opt Au/.3 m
Cominco Limited	lots 1-3 Con VI	1984	3 ddh - 397 m	assays not reported
Falconbridge Gold Corporation	lot 5, 6 Con II	1992	mag and VLF-EM	no follow up reported
Falconbridge Gold Corporation	lots 9,10 Con V, VI	1993	IP survey	no follow up reported
Falconbridge Limited	lot 7, Con V	1993	HLEM, mag, geology, 1 ddh - 206 m	2.7 g/t Au/1.5 m best assay reported
Ginn, A.P.	lot 5, Con II	1988	geology, mag, VLF-EM, 2 ddh - 424 m	.018 opt Au/.76 m best assay
Hollinger Consolidated Gold Mines Limited	various lots in Twp.	1964	several ddh	significant Au encountered on Jeffris Patent (see below)
Hobbs, L.G.	lot 10 Con II, lot 11 Con III	1984	ground mag	no follow up reported
Jeffris Patent	lots 11, 12, Con III	?	several ddh - logs and depths no reported	Au to .63 opt? / 1.5 m
Jemmett, F.	lot 2, Con III	1987	trenching	results not reported
Jennex Limited	lots 5-8, Con II	1988	HLEM and mag	no follow up reported
Lac Minerals Limited	lot 2, Con II	1987	1 ddh - 203 m	assays not reported
Maude Lake Gold Mines Limited	lots 1-5, Con VI	1988	geology, mag, VLF-EM, RCD, 2 ddh - 213 m	.018 opt Au / .9 m best assay
McChristie, N	lots 5,6 Con II	1990	2 ddh	locations not precise

Ontario Geological Survey	twp.	1985	8 sonic drill holes	results reported Pmap 2986
Parsons, C.E.	lot 1, Con II	1991	3 ddh - 347 m	best assay .04 opt Au/.75 m
Parsons, C,E.	lot 4, Con II	1993	1 ddh - 122 m	best assay 4.66 opt Au /.6 m
Pentland Firth Ventures Limited	lots 5-11 Con IV, V	1995	mag, IP surveys, 5 ddh - 1500 m	best assay 1030 g/t Au /.3 m; .35% Cu / 30 m
Phibbs, Harley	lot 2, Con IV	1991	stripping, mag	no follow up reported
Pyke, D.R. (Carlo Showing)	lots 1-3, Con VI	1987	stripping, mag, RCD, VLF-EM, soil and rock geochem, geology	no significant results reported
Riddell Property	lot 2-3, Con VI	1939	geology	no follow up reported
Shogrin Minerals Incorporated	lot 11, Con I, lot 10 Con II	1984	ground mag and VLF-EM	no follow up reported
Wilcarr Mines Limited	lots 1-4, Con VI	1944	44 ddh	low grade Au and asp reported in several holes

Appendix 3

Table 7 - DRILL HOLE COMPILATION; MONTEITH AREA

DIAMOND DRILL HOLES

Sta #	Easting	Northing	Company Name	Azimuth	Dip	Twp
CA0100	537556	538322	FALCO CARR53-02	190	-50	Carr
CA0101	539344	537834	PARSONS 90-1	0	-80	Carr
CA0102	539099	537836	PARSONS 90-2	0	-80	Carr
CA0103	539026	537842	HOLLINGER C-4	0	-55	Carr
CA0104	542238	538491	COMINCO CW-1	180	-50	Carr
CA0105	542244	538484	COMINCO CW-3	210	-55	Carr
CA0106	539513	537821	ASARCO DCR-1	0	-45	Carr
CA0107	539758	538478	MAUDE LAKE WC86-1	190	-50	Carr
CA0108	539525	538485	MAUDE LAKE WC86-2	190	-55	Carr
CA0109	537855	538343	CANAMAX 69-29-1	180	-50	Carr
CA0110	537304	538400	CANAMAX 69-29-2	180	-45	Carr
CA0111	541145	537893	LAC C-4-87	0	-55	Carr
CA0112	542555	538407	HOLLINGER E-3	225		Carr
CA0113	535917	538380	PENTLAND PMC-3	180	-45	Carr
CA0114	535626	538277	PENTLAND PMC-4	180	-50	Carr
CA0115	537073	538391	PENTLAND PMC-5	135	-50	Carr
CA0116	539723	537832	PARSONS 93-1	0	-70	Carr
CA0117	537426	538418	PENTLAND PMC-1	190	-50	Carr
CA0118	536920	538408	PENTLAND PMC-2	179	-50	Carr
CA0119	542409	537811	PARSONS 91-1	0	-45	Carr
CA0120	542497	537811	PARSONS 91-3	10	-45	Carr
CA0121	540017	537826	PARSONS 92-2	0	-70	Carr
CA0122	539869	537826	PARSONS 92-3	0	-70	Carr
CA0123	537867	537839	HOLLINGER C-1	6	-55	Carr
CA0124	537329	537838	HOLLINGER C-6	0	-55	Carr
CA0125	537057	537842	HOLLINGER C-7	0	-55	Carr
CL0100	521788	539412	AMAX 34-06-1	180	-55	Clergue
CL0101	523012	539390	AMAX 34-7-1	180	-50	Clergue
CL0102	521757	538572	NAHANNI CS-81-1	345	-60	Clergue
CL0103	521383	538576	NAHANNI CS-83-2	165	-50	Clergue
CL0104	514985	538978	FALCO 1-73	180	-48	Clergue
CL0105	515373	539019	FALCO 2-73	180	-50	Clergue
CL0106	518748	538974	LAC CL-5-A	180	-45	Clergue
CL0107	522286	538629	DALHOUSIE DC801	170	-50	Clergue
CL0108	516246	538788	DOMINION GULF -1	0	-90	Clergue
CL0109	516256	538779	DOMINION GULF -2	325	-45	Clergue
CL0110	516102	538778	DOMINION GULF -3	325	-45	Clergue
CL0111	514409	538691	DOMINION GULF DG-4B	145	-45	Clergue
CL0112	514327	538687	DOMINION GULF DG-5	0	-50	Clergue
CL0113	515565	538722	DOMINION GULF -7A	122	-50	Clergue
CL0114	516003	539025	DOMINION GULF H-12	32	-45	Clergue
CL0115	515293	539060	DOMINION GULF H-13	5	-48	Clergue
CL0116	522988	538597	CSM-2-86	349	-50	Clergue
CL0117	523141	538604	CSM-3-86	169	-50	Clergue
CL0118	514023	538545	CL95-1 (SALO)	350	-56	Clergue
CL0119	515558	538661	HOLLINGER #3	333	-55	Clergue
CL0120	515386	538654	HOLLINGER #4	333	-55	Clergue
CL0121	516078	538934	INCO 40640	30	-45	Clergue
CL0122	515631	538917	INCO 40648	30	-50	Clergue
CL0123	514451	538969	INCO 40647	180	-50	Clergue

CL0124	514212	538995	INCO 40645	180	-50	Clergue
CL0125	515109	538785	INCO 40643	30	-50	Clergue
CL0126	516453	538773	INCO 40641	30	-45	Clergue
CL0127	516299	538934	INCO 40649	30	-50	Clergue
CL0128	514575	538797	INCO 40650	0	-50	Clergue
CL0129	514564	538842	SELCO #1	0	-50	Clergue
TA0100	532421	537902	PROSPECTORS AIRWAYS PA-1	180	-88	Taylor
TA0101	528905	537910	HOLLINGER T-1	350	-55	Taylor
TA0102	526678	537836	HOLL T3C-64-84	0	-90	Taylor
TA0103	526678	537711	HOLLINGER T5E-26-80	0	-55	Taylor
TA0104	528908	537916	HOLLINGER HT-3	349	-55	Taylor
TA0105	528895	537927	HOLLINGER HT-4	349	-55	Taylor
TA0106	528932	537912	HOLLINGER HT-5	315	-55	Taylor
TA0107	523894	537822	HOLLINGER HT-16	0	-55	Taylor
TA0108	524260	537821	HOLLINGER HT-17	0	-55	Taylor
TA0109	527162	538534	HOLLINGER B-1	0	-55	Taylor
TA0110	526879	538469	HOLLINGER B-2	0	-55	Taylor
TA0111	524875	537863	QUEBEC STURGEON RIVER 79	0	-52	Taylor
TA0112	525023	537883	QUEBEC STURGEON RIVER 81	0	-55	Taylor
TA0113	531856	537892	HOLLINGER HT-53	0	-60	Taylor
TA0114	525105	537854	HOLLINGER T-1	166	-55	Taylor
TA0115	530385	537917	GOLDEX T86-5	350	-55	Taylor
TA0116	530580	537918	GOLDEX T86-6	350	-55	Taylor
TA0117	529675	537917	GOLDEX T86-9	350	-65	Taylor
WA0100	525107	538623	CARLSON-GINN 1-81	160	-45	Walker
WA0101	525107	538604	CARLSON-GINN 2-81	340	-45	Walker
WA0102	524978	538603	CARLSON-GINN 3-81	340	-45	Walker
WA0103	532886	539065	NORANDA #3	180	-60	Walker
WA0104	526510	538572	NAHANNI ER-82-1	155	-60	Walker
WA0105	524817	538579	NAHANNI WR-82-1	150	-63	Walker
WA0106	531059	539237	HOLLINGER 1-79	176	-55	Walker
WA0107	531074	539215	HOLLINGER 2-79	176	-55	Walker
WA0108	524080	538654	CANAMAX 69-26-1	170	-45	Walker
WA0109	527324	538608	CARLSON-GINN 4	20	-59	Walker
WA0110	532856	538720	MONPRE #1	180	-60	Walker
WA0111	532935	538743	MONPRE #2	180	-55	Walker
WA0112	532641	538699	MONPRE #3-A	180	-55	Walker
WA0113	532988	538668	MONPRE #4	160	-50	Walker
WA0114	529564	539309	AMAX 1131-09-1	180	-50	Walker
WA0115			NORANDA W-81-3B	30	-52	Walker
WA0116	528644	538656	HOLLINGER WA2-1-79	180	-50	Walker
WA0117	532961	538859	FALCO WA26-01	181	-57	Walker
WA0118	532445	538812	FALCO WA26-02	180	-52	Walker
WI0100	534242	539157	FALCO WI41-04	180		Wilkie
WI0101	534088	539170	MATTAGAMI T4A-80-1	180	-50	Wilkie
WI0102	533510	539093	MATTAGAMI T4A-80-2	180	-55	Wilkie
WI0103	533977	539256	MATTAGAMI T4A-80-3	180	-50	Wilkie
WI0104	533376	539200	NORANDA 65-1	180	-55	Wilkie
WI0105	534325	539072	NORANDA 65-2	180	-60	Wilkie
WI0106	535366	539066	HOLLINGER WI4-1-79	180	-55	Wilkie
WI0107	534565	539254	FALCO WI51-01	180	-50	Wilkie
WI0108	539717	538701	FALCO WI15-01	180	-50	Wilkie
WI0109	541058	538851	FOURNIER #6	0	-48	Wilkie
WI0110	540587	538670	HOLLINGER WI2-1-77	180	-60	Wilkie

WI0111	542140	538871	AMAX 1035-02-1	180	-45	Wilkie
WI0112	533377	538865	FALCO WI21-01	180	-50	Wilkie
WI0113	533830	538878	FALCO WI21-06	180	-50	Wilkie
WI0114	535093	538818	FALCO WI22-01	180	-60	Wilkie
WI0115	535710	538788	FALCO WI22-07	180	-50	Wilkie
WI0116	534956	538871	FALCO WI22-08	180	-60	Wilkie
WI0117	536109	538811	FALCO WI22-09	180	-55	Wilkie
WI0118	536127	538779	FALCO WI22-10	180	-55	Wilkie
WI0119	535702	538852	FALCO WI22-17	349	-45	Wilkie
WI0120	535638	538845	FALCO WI23-01	180	-50	Wilkie
WI0121	536907	538801	FALCO WI23-02	180	-55	Wilkie
WI0122	534887	538777	FALCO WI22-02	180	-55	Wilkie
WI0123	537770	538924	FALCO WI33-01	0	-50	Wilkie
WI0124	536576	539221	HOLLINGER WI3-1-80	198	-55	Wilkie
WI0125	536576	539221	HOLLINGER WI3-2-80	18	-55	Wilkie
WI0126	541235	539109	TWIN FALLS SYNDICATE #9	30	-52	Wilkie
WI0127	537629	539047	ASARCO NB90-1	180	-60	Wilkie
WI0128	538329	539000	ASARCO NB90-2	180	-50	Wilkie
WI0129	539809	538948	ASARCO NB90-3	180	-50	Wilkie
WI0130	538323	539061	GLEN AUDEN WC-93-A	180	-55	Wilkie
WI0131	541192	538555	MAUDE LAKE WC86-3	25	-50	Wilkie
WI0132	540952	538562	MAUDE LAKE WC86-4	25	-55	Wilkie
WI0133	539276	538540	MAUDE LAKE E88-9	0	-60	Wilkie
WI0134	533208	538545	CANAMAX 69-01-1	0	-50	Wilkie
WI0135	534197	538598	CANAMAX 69-01-2	0	-50	Wilkie
WI0136	535755	538659	CONTINENTAL COPPER VW65-1	180	-45	Wilkie
WI0137	534040	538672	CONTINENTAL COPPER VW65-2	180	-45	Wilkie
WI0138	535047	538658	NAHANNI WI-81-1	180	-55	Wilkie
WI0139	535847	538655	NAHANNI WI-81-2	180	-50	Wilkie
WI0140	533243	539201	FALCO WI41-01	180	-50	Wilkie
			SONIC DRILL HOLES			
500	538640	538242	OGS 84-01			Carr
501	541173	538220	OGS 84-02			Carr
502	542716	538033	OGS 84-05			Carr
503	541099	537800	OGS 84-07			Carr
504	536347	537861	OGS 84-21			Carr
505	533279	537718	OGS 84-23			Carr
506	531545	538467	OGS 84-38			Taylor
507	531547	538320	OGS 84-39			Taylor
508	529299	538211	OGS 84-40			Taylor
509	533169	538169	OGS 84-41			Carr
510	529963	537902	OGS 84-22			Taylor
511	526814	537646	OGS 84-27			Taylor
512	523553	537904	OGS 84-34			Taylor
513	528344	538480	OGS 84-42			Taylor
514	526676	537893	OGS BH-1 (SHOOTZONE)			Taylor
515	526373	537896	OGS BH-2			Taylor
516	526441	537877	OGS BH-3			Taylor
517	526443	537869	OGS BH-4			Taylor
518	526533	537869	OGS BH-5			Taylor
519	526366	537880	OGS BH-6			Taylor
520	526255	537882	OGS BH-7			Taylor
521	526156	537909	OGS BH-8			Taylor
522	525971	537897	OGS BH-9			Taylor

523	526253	537899	OGS BH-10	Taylor
524	526096	537883	OGS BH-11 (SHOOTZONE)	Taylor
525	526100	537869	OGS BH-12	Taylor
526	526258	537848	OGS BH-13	Taylor
527	526282	537827	OGS BH-14	Taylor
528	526250	537867	OGS BH-15	Taylor
529	526372	537889	OGS BH-16	Taylor
530	526671	537870	OGS-BH-17	Taylor
531	526594	537886	OGS BH-18	Taylor
532	526569	537900	OGS BH-19 (SHOOTZONE)	Taylor
533	523426	539507	91-4814-188	Clergue
534	518030	539345	OGS-85-04	Clergue
535	514573	539347	OGS 85-05	Clergue
536	518663	538863	OGS 85-06	Clergue
537	537298	538695	OGS 87-10	Wilkie
538	535315	538855	OGS 87-11	Wilkie
539	539915	538862	OGS 87-12	Wilkie
540	539401	538533	OGS 87-13	Carr
541	541846	539141	OGS 87-17	Wilkie
542	540960	539306	OGS 87-18	Wilkie
543	538801	539390	OGS 97-19	Wilkie
544	536800	539280	OGS 87-20	Wilkie
545	532365	539297	OGS 87-21	Walker
546	532892	539092	OGS 87-22	Walker
547	532244	538594	OGS 85-01	Walker
548	529934	538800	OGS 85-02	Walker
549	523575	538534	OGS 85-07	Taylor
550	532086	539299	OGS 88-49	Walker
551	525080	538226	OGS 85-59	Taylor

Metric Conversion Table

Conversion from SI to Imperial			Conversion from Imperial to SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
			LENGTH		
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
			AREA		
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
			VOLUME		
1 cm^3	0.061 023	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.307 951	cubic yards	1 cubic yard	0.764 554 86	m^3
			CAPACITY		
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
			MASS		
1 g	0.035 273 962	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 747	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 622 6	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311 3	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 90**	t
			CONCENTRATION		
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

	Multiplied by	
1 ounce (troy) per ton (short)	31.103 477	grams per ton (short)
1 gram per ton (short)	0.032 151	ounces (troy) per ton (short)
1 ounce (troy) per ton (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

Note: Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries, published by the Mining Association of Canada in co-operation with the Coal Association of Canada.

MAPS NOT FILMED

CARTES NON REPRODUITES